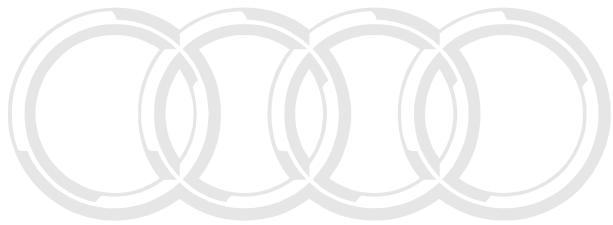


Repair Manual

Audi 80 1992 ➤ , Audi 100 1991 ➤ ,
Audi A2 2001 ➤ , Audi A3 1997 ➤ ,
Audi A4 1995 ➤ , Audi A4 2001 ➤ ,
Audi A4 Cabriolet 2003 ➤ ,
Audi A6 1998 ➤ , Audi A8 1994 ➤ ,
Audi A8 2003 ➤ , Audi Cabriolet 1991 ➤ ,
Audi A3 2004 ➤ , Audi TT 1999 ➤ ,
Audi A6 2005 ➤ , Audi Q7 2007 ➤ ,
Audi TT 2007 ➤ ,
Audi TT Roadster 2007 ➤ ,
Audi R8 2007 ➤ , Audi A5 Coupé 2008 ➤ ,
Audi A4 2008 ➤ , Audi A4 China 2001 ➤ ,
Audi A6 China 2005 ➤ ,
Audi A3 Cabriolet 2008 ➤ ,
Audi Q5 2008 ➤ , Audi A4 Avant 2008 ➤ ,
Audi A5 Cabriolet 2009 ➤ ,
Audi A5 Sportback 2010 ➤ ,
Audi A8 2010 ➤ , Audi R8 Spyder 2010 ➤ ,
Audi A1 2011 ➤ ,
Audi A7 Sportback 2011 ➤ ,
Audi A6 2011 ➤ , Audi R8 GT 2011 ➤ ,
Audi Q3 2012 ➤ , Audi A6 Avant 2011 ➤ ,
Audi R8 GT Spyder 2012 ➤ ,
Audi A3 2013 ➤ ,
Audi A3 Sportback 2013 ➤ ,
Audi A6 China 2012 ➤ ,
Audi A3 e-tron 2012 ➤ ,
Audi Q3 China 2013 ➤ ,
Audi Q5 China 2010 ➤ ,
Audi A3 Limousine 2014 ➤ ,

Audi A3 Cabriolet 2015 ➤ ,
Audi A3 Limousine China 2014 ➤ ,
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Audi TT 2015 ➤ , Audi Q7 2016 ➤ ,
Audi TT Roadster 2015 ➤ ,
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Audi R8 2015 ➤ , Audi R8 Spyder 2016 ➤ ,
Audi A4 allroad quattro 2016 ➤ ,
Audi A4 China 2016 ➤ , Audi Q5 2017 ➤ ,
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Audi A7 Sportback 2018 ➤ ,
Audi A6 2019 ➤ , Audi Q5 China 2019 ➤ ,
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Audi Q3 China 2019 ➤ ,
Audi Q3 Sportback 2020 ➤ ,
Audi Q3 Sportback China 2020 ➤ ,
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Audi A3 Limousine 2020 ➤ ,
Audi A3 Limousine China 2021 ➤ ,
Audi e-tron GT 2022 ➤ ,
Audi Q4 e-tron China 2022 ➤ ,
Audi Q8 e-tron 2024 ➤

Body - General Information



Edition 06.2024



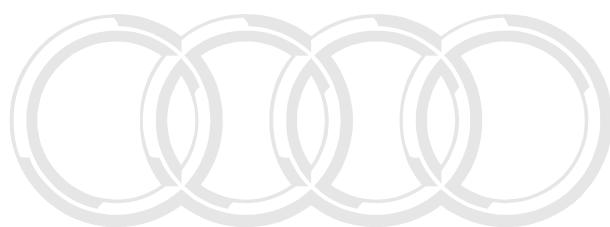
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List of Workshop Manual Repair Groups

Repair Group

52 - Body, General Information

The erWin logo, featuring the word "erWin" in a stylized, blocky font with a small robot head icon integrated into the letter "e".

Technical information should always be available to the foremen and mechanics, because their careful and constant adherence to the instructions is essential to ensure vehicle road-worthiness and safety. In addition, the normal basic safety precautions for working on motor vehicles must, as a matter of course, be observed.

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52 – Body, General Information

1 Training/Personnel Qualification

(Edition 06.2024)

A00.5A04.82.21 -- 7/10/2024

⇒ [“1.1 Qualification”, page 1](#)

1.1 Qualification

To be able to perform a perfect and process-safe repair in the workshop, the vehicle specific training modules are required.

Refer to ⇒ Rep. Gr. 00 : Training/Personnel Qualification:

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2 Safety Precautions

- ⇒ [“2.1 Safety Precautions”, page 2](#)
- ⇒ [“2.2 Safety Precautions when Working on Cooling System”, page 4](#)
- ⇒ [“2.3 Safety Precautions during Road Test with Testing Equipment”, page 5](#)
- ⇒ [“2.4 High-Voltage Components / Electric Vehicles”, page 5](#)

2.1 Safety Precautions

Follow all country-specific regulations regarding accident prevention and safety on the workplace.

Welding and sanding must always be carried out with Ventilation System .

 WARNING
<p>Risk of explosion due to dust concentration and aluminum and steel when sanding and separating.</p> <p>There is a risk of fatal or serious bodily injury due to an explosion.</p> <ul style="list-style-type: none">– Check and clean the exhaust extraction system before beginning work on the functions.– Extract accumulating sanding dust with the respective permitted vacuum cleaner for the material.– Always separate the dust from different materials (separate aluminum steel and carbon fiber-reinforced polymer (CFRP)).– Keep the work station free of aluminum and steel dust. Remove the dust accumulation.– Do not blow out the accumulated with compressed air.– Never weld and sand in the same room at the same time.– To prevent external sparks, if possible use only air driven sanding and removal devices.– Empty the extraction system after using.– Prevent water and moisture when separating and sanding.

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Refer to ⇒ [“3.1 Notes for Working with Fine, Aluminum and Steel Dust”, page 6](#)

Composite Material Safety Precautions (Carbon Fiber-Reinforced Polymer (CFRP))

Refer to ⇒ [“7.5.5 Important Notes for Carbon Fiber-Reinforced Polymer \(CFRP\)”, page 25](#)

Risk due to hazardous gases.

Sparks are created when welding and separating. If the sparks touch foamed areas within the body hazardous gases will be created.

- Do not perform welding or separating with spark producing devices or tools in the near of foamed areas.

WARNING

Risk of the fuel tank or fuel-carrying components exploding due to sanding, welding or separating.

Severe injuries and burns are possible.

- When sanding, welding or separating near the fuel system remove the fuel tank or fuel-carrying components.

DANGER

There is a risk of explosions and fatal injuries due to damaged natural gas tanks.

- The natural gas tank must be checked for damage if components in the rear side or rear area are removed due to damage, such as the bumper cover, rear lid, underbody trim panels, longitudinal members, rear lid end piece, etc.
- Check for damage on fuel tanks. Refer to ⇒ Natural Gas System - General Information; Rep. Gr. 20 ; Fuel Tanks, Checking for Damage .

CAUTION

Risk of injury due to flying metal shavings.

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Irritation and injury to skin and eyes possible. AUDI AG does not guarantee or accept any liability
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- Wear protective eyewear.
- Wear safety gloves.

CAUTION

Health risk due to dusts possible.

Irreversible deposit of dust particles in the lungs. Breathing impairments possible from sanding and separating work.

- Wear a dust mask.
- Use proper extraction.
- No cutting procedures on carbon fiber-reinforced polymer (CFRP) materials.

CAUTION

If welding, soldering or cutting with spark-producing tools in foamed areas hazardous gases are produced.

- Never weld, solder or separate within 15 mm of molded foam parts.
- Perform the procedures with extraction.

Welding and sanding must be carried out with ventilation.

Never weld and sand in any area at the same time.

Clean the work area regularly depending on the amount of dust.

Do not blow out the accumulated with compressed air.

Empty the extraction system after usage.

Follow all country-specific regulations regarding accident prevention and safety on the workplace.

Bonded Joints, Detaching

Body bonded joints can be detached by applying heat. The adhesives used in the vehicle construction and the repair are destroyed at temperatures 180 – 200°C (392 °F).



- ◆ Wear protective gloves and eyewear.
- ◆ Avoid direct contact of the adhesives with the skin.
- ◆ Avoid inhaling solvent vapors.
- ◆ Only process adhesives in well-ventilated areas.
- ◆ Always note the hazard information from the manufacturer.
- ◆ Also note the accident prevention regulations applicable in the respective country.
- ◆ Note the corresponding safety data sheets for the adhesive.
- ◆ Use suitable extraction.

Galvanized Body Parts



When welding zinc-coated sheet steel panels, toxic zinc oxide develops in the welding emissions.

- Perform the procedures with extraction.



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2.2 Safety Precautions when Working on Cooling System

There is a risk of scalding due to hot coolant.

The cooling system may be under pressure. There is a risk of scalding due to hot steam and hot coolant.

- Wear safety gloves.
- Wear protective eyewear.
- Reduce the pressure by covering the coolant expansion tank cap with a suitable towel and carefully opening it.

There is a risk of injury if the parking heater and A/C activates.

The parking heater and A/C can switch on unintentionally on electric and hybrid vehicles with an activated parking heater and A/C. Parts of the body can be pinched or pulled if the radiator fan or the fresh air blower starts to run by itself, or by moving parts of the heater and A/C unit

- Deactivate the parking heater and A/C and its timer functions.

2.3 Safety Precautions during Road Test with Testing Equipment

There is a risk of injury from unsecured testing equipment.

If the front passenger side airbag unit deploys during an accident, testing equipment that is not properly secured will be thrown around dangerously.

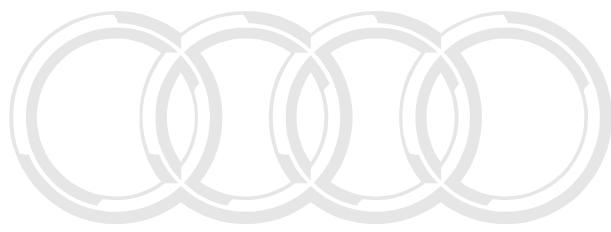
- Secure testing equipment on the rear seat.
- Have a second person operate the testing equipment on the rear seat.
- In vehicles with two seats, deactivate the front passenger airbag and move the front passenger seat as far back as possible.

2.4 High-Voltage Components / Electric Vehicles

There is a risk of fatal injury due to high voltage if high-voltage components and cables are damaged.

The high-voltage system is under high voltage. Electrocution by direct contact or electric arc can cause fatal or serious bodily injury if high-voltage components and high-voltage cables are damaged.

- Visually inspect the high-voltage components and the high-voltage cables.
- Do not use cutting, shaping, or sharp-edged tools near high-voltage components and high-voltage cables.
- Do not weld, solder, or use thermal bonding or hot air near high-voltage components and high-voltage cables.



Audi

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3 Repair Information

- ⇒ “3.1 Notes for Working with Fine, Aluminum and Steel Dust”, page 6
- ⇒ “3.2 Adhesive Surfaces for Adhesive Tape”, page 7
- ⇒ “3.3 Secured Threaded Connections”, page 7
- ⇒ “3.4 Identification Plates”, page 7
- ⇒ “3.5 Impact Wrenches”, page 7
- ⇒ “3.6 Multi-Material Mix”, page 8
- ⇒ “3.7 Removal Method on Multi Material Body Repair Station”, page 8
- ⇒ “3.8 Battery, Voltage Supply”, page 9
- ⇒ “3.9 A/C System / Refrigerant”, page 10
- ⇒ “3.10 Electronic Control Modules”, page 10

3.1 Notes for Working with Fine, Aluminum and Steel Dust

Separation of aluminum and steel dust

All emissions of the new lightweight materials fall under the hazardous materials ordinance (national regulations). These require, independently from all repair quality related guidelines by the vehicle manufacturer, a risk analysis by the company performing the repair.

The employers may permit work with hazardous substances only after, a risk assessment has been performed and the required safeguard measures have taken place.

This means in the specific case, each repairing workshop is legally obligated to create such risk assessment, before the procedures are started or continued.

Fine aluminum dust

Physical:

- ◆ Aluminum dust is combustible and depending on the particle size and concentration, explosive

Chemical:

- ◆ Aluminum dust and water produce a combustible/explosive hydrogen gas
- ◆ Aluminum dust + ferric oxide (rust) react under heat with each other (exothermic redox reduction)
- ◆ Aluminum dust + ferric oxide + strong ignition sources can, at a mixture ratio of 1:3, cause a thermite reaction. This metal fire burns at a temperature of up to 2400 °C and cannot be extinguished with water.
- ◆ Aluminum dust is a hazardous material and must be properly extracted according to the local regulations.

Fine steel dust

Physical:

- ◆ Steel particles can be statically charged and even cold can become an ignition source for the aluminum dust.

- ◆ Flying sparks from steel processing provides the perfect ignition source for aluminum dust.
- ◆ When performing a sandwich cut through steel and aluminum the explosive aluminum dust and also the ignition source emerge at the same time.

Chemical:

- ◆ Aluminum dust + ferric oxide (rust) react under heat with each other (exothermic redox reduction)
- ◆ Aluminum dust + ferric oxide + strong ignition sources can, at a mixture ratio of 1:3, cause a thermite reaction. This metal fire burns at a temperature of up to 2400 °C and cannot be extinguished with water.

3.2 Adhesive Surfaces for Adhesive Tape

- ◆ The vehicle must be at room temperature before installing, for example self-adhesive covers, door seals, etc. with adhesive tape.
- ◆ The adhesive surfaces on the body must be free of dust and grease.
- ◆ Clean the adhesive surfaces using Cleaning Solution - D 009 401 04- .
- ◆ After installing, press on the covers with adhesive tape using a roller.
- ◆ After installing, pull on the components by hand to check for a secure fit.

3.3 Secured Threaded Connections

Installed bolts that are »microencapsulated« must be replaced, and the threaded holes must be cleaned with a suitable thread tap.

3.4 Identification Plates

- ◆ When replacing components, the existing identification plates on the used parts that indicate the replacement part number in the ⇒ Electronic Parts Catalog (ETKA), must be transferred to the new part according to the specifications.
- ◆ Replace any identification, warning and information labels on vehicle components that are unreadable or damaged, and re-attach them in the same location. For the allocation, refer to the ⇒ Electronic Parts Catalog (ETKA).

3.5 Impact Wrenches

Pay attention to additional information in the repair manual.

Exceptions:

- ◆ No impact wrenches are allowed when working within an opened high-voltage battery and when working near natural gas systems. Pay attention to the general information.

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- ◆ **Removing bolts and nuts using a suitable impact wrench is generally permitted.**

- ◆ Bolts (bolt head and protruding threads) and nuts must be cleaned before removal.

Installing/attaching:

Installing and attaching nuts is permitted using a suitable impact wrench when paying attention to the following conditions.

- ◆ Position the bolts and nuts by hand.
- ◆ Only use an impact wrench with an adjustable speed and torque range.
- ◆ The impact function of the impact wrench may not be used.
- ◆ The maximum speed must not exceed 300 RPM.
- ◆ Use suitable screwdriver bits (for example plastic-coated bits) close to delicate surfaces.
- ◆ Install or attach bolts with locking fluid or self-locking nuts with low speed.
- ◆ Only install or attach bolts and nuts until they stop.
- ◆ Apply the additional tightening specification by hand using a torque wrench.
- ◆ Use a torque wrench with angled rotation function or a rigid torque wrench for the prevailing angle of torque.

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3.6 Multi-Material Mix

In addition to the traditionally pure steel body, there is an increase in mixed-material body construction. This means that a combination of various materials are being used together.

The most common materials in modern vehicle bodies are:

- ◆ Steel (in varying strengths)
- ◆ Aluminum
- ◆ Magnesium
- ◆ Plastics
- ◆ Fiber-reinforced plastic
- ◆ Carbon fiber materials

3.7 Removal Method on Multi Material Body Repair Station



Note

- ◆ *The Ruwac NA35 Wet Collection for Explosive Materials (VAS 6572/1) and the VAS 6572/2 must be emptied before and after every operational use.*
- ◆ *Pay attention to the safety precautions. Refer to ⇒ Body Repair; Rep. Gr. 00 ; Safety Precautions .*

Fine aluminum dust

Fine aluminum dust is combustible and/or explosive. Technical equipment must be handled so that no external ignition sources can pass into the filter or the dust collection container. The stationary "genuine" aluminum vacuum stations used through 2009

(Dansk Klimablock / Aeroweld or Nederman) do not offer the technical equipment protection and also cannot be retrofitted. All these suction devices and the aluminum vacuum devices available on the market are without exception "ignition source free". For this reason vehicles with steel parts and on which flying sparks from the steel components cannot be completely prevented must NOT be worked on in this area.

The Ruwac NA35 Wet Collection for Explosive Materials VAS 6572/1 (dust class M) from 2009 and the VAS 6572/2 (dust class H) have a 3-part protection against the intake of friction sparks from the possible steel processing. This protection is made of a 5 m (16.4 feet) long antistatic suction hose, the so-called spark trap and a 5 m (16.4 feet) long flow calming section. This ensures that also by unintentional sanding of steel components the glowing sparks are cooled well below the ignition temperature of the aluminum dust. The system has the German Technical Inspection Agency certificate for considerably hotter and longer glowing steel sparks.

A second risk is the static charging of metal particles due to friction in the hoses and pipes during the suction process. This static charge can function as an ignition source in the same way as a glowing spark. To make sure that only the antistatic so called "Ohm hoses" can be installed, the connection coupling of the extraction system and hoses have an error safe Storz-C coupling on the suction side.

The third risk is the suction device's possible impact as an ignition source on the surrounding area. Because this suction device is based on industrial vacuum cleaners it automatically has all constructive features for the use in zone 22 and to prevent a possible impact as an ignition source in the working environment. For accident repairs the work procedures such as cutting, grinding and welding automatically produce more ignition sources than a suction device can.

Fine steel dust

Steel sparks and dust are considered to be risk free. In multi material mixed work stations the steel flying sparks present the greatest risk potential for the fine aluminum dust! For this reason and in compliance with the process separation, a steel vacuum must always be provided which is also allocated to always remain at the body work station. Generally only aluminum vacuums are used because they have a tested spark trap, that could be equal to the explosion protection device heat test, while the vacuum sits next to the worker in the work area during this procedure. The Ruwac NA35 Wet Collection for Explosive Materials VAS 6571/1 is based on the same basic machine as the VAS 6572/2, but without a 3-part spark trap. It is suitable for use in zone 22. The filter is dust class "M" like those suitable for the metal dust.

3.8 Battery, Voltage Supply



Note

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Make sure the radio code is available before disconnecting the battery. Before giving the vehicle to the customer, enter the correct code number to make the radio ready to play.

Before welding, you must remove both battery terminal clamps and cover both battery terminals.

You must remove the vehicle battery before performing work near the battery that could produce sparks.

3.9 A/C System / Refrigerant

⇒ “3.9.1 Corrective Measure:”, page 10

Never weld or hard/soft solder components of a filled A/C system. This also applies to welding and soldering on the vehicle, if there is a risk that it may heat up components in the A/C system. When performing paint repairs, objects in the drying oven or its pre-warming area may only reach 80 °C (176 °F). This is because warming causes high pressure to develop in the pressure relief valve on the A/C compressor.



Note

Coolant systems must also be extracted if electrical welding will take place around coolant lines. When welding electrically, invisible ultraviolet rays are released that penetrate the coolant hoses and damage the coolant.

3.9.1 Corrective Measure:

Evacuate the refrigerant circuit. Refer to ⇒ Heating, Ventilation and Air Conditioning; Rep. Gr. 87 ; Heating and A/C System

3.10 Electronic Control Modules

Connect electric welder ground (GND) connector directly to the piece to be welded. When doing so, be careful that there are no electrically isolated parts located between the ground connection and the welding location.

Do not touch electronic control modules and electrical wires with the ground connection or welding electrode.

Replacing electronic control modules after a collision is only required if at least one of the following conditions is met:

- ◆ The housing is distinguishably deformed or damaged.
- ◆ The contact surface or bracket is deformed; the device shows no damage on the outside.
- ◆ The connector is damaged or corroded by moisture.
- ◆ The function test or OBD of the device shows the fault: “Control module faulty”.

If electronic components, for example the ABS control modules, are removed for repair work and then reinstalled, they must be checked for function according to available information after assembly, using OBD, for example.

4 Body Repair General Information

- ⇒ [“4.1 Original Joint”, page 11](#)
- ⇒ [“4.2 Galvanized Body Parts”, page 11](#)
- ⇒ [“4.3 Remaining Material, Removing”, page 11](#)
- ⇒ [“4.4 New Parts”, page 11](#)
- ⇒ [“4.5 Molded Foam Parts”, page 12](#)

When repairing, the original joint should always be restored.

Standard repairs are described in the repair manual. Further descriptions are not given because if there are more extensive repairs, the damaged area should be removed at the original joint. Where this is possible, the joining techniques can be implemented according to the preceding comparison.

All repairs with special separating cuts and joining techniques that do not correspond to the original joint (production status) are checked and approved by the technical development team by evaluating, strength testing and crash testing.

4.1 Original Joint

“Original joint” refers to a connection that was created by the vehicle manufacturer.

These connections should be reconstructed when performing body repairs.

When doing so, ensure that the production number of weld points does not fall short when making repairs.

Methods and procedures differing from the original connection are described in the applicable body repair manual.

4.2 Galvanized Body Parts

Fully galvanized body parts enable a high level of corrosion protection in body. To maintain the warranty against perforation corrosion even if a repair is required, then the procedures in chapter Refer to ⇒ [“15 Corrosion Protection”, page 80](#) must be followed precisely.

4.3 Remaining Material, Removing

If the damaged body part is cut out roughly, for example using a body saw, based on the separation cuts in the corresponding repair manual, then have most of the spot-welded bonded joints drilled out with the spot weld breaker.

In addition, we recommend the degree sander as well as an angle grinder to remove the weld connections that cannot be removed with the spot weld breaker.

4.4 New Parts

New parts that are no longer accessible after the repair, for example the side sill, should have corrosion protection installed on them before welding for corrosion protection reasons. It is advisable to cover the welding flange when doing so.

Additional information can be found in the paint manual.

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Check new replacement parts such as doors, panels or fenders for transport damage before sending to paint shop. This prevents double painting, if transport or accident damage to the vehicle is noticed during assembly.

4.5 Molded Foam Parts

⇒ “4.5.1 Prerequisites”, page 12

⇒ “4.5.2 Molded Foam Part, Replacing”, page 12

The molded parts are installed in the body shell and increase in volume after priming them in the paint drying-oven from approximately 180 °C (356 °F).

When using molded foam parts, proceed as follows:

- ◆ Remove any remaining foam from the vehicle.
- ◆ Create the paint structure according to the paint manual.

4.5.1 Prerequisites

Before inserting a molded foam part, the metal part to be replaced must be prepared so that it is ready for installation, for example, cutting, fitting, corrosion protection measures.

4.5.2 Molded Foam Part, Replacing

- ◆ Cover the molded foam part all around with butyl sealing cord or two-part filler foam.
- ◆ Secure the molded foam part on the vehicle.
- ◆ Secure the new part (for example, A-pillar) while gently pressing on it around the molded foam part until it makes contact and then weld it in.
- ◆ Do not perform gas-shielded welding within at least 40 mm next to the molded foam part (on both sides)
- ◆ After painting the vehicle, seal the cavities in the repair area.

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5 Explanation of Symbols

- ⇒ “5.1 Symbols for Removing Components”, page 13
- ⇒ “5.2 Symbols for Welding and Soldering”, page 13
- ⇒ “5.3 Symbols for Rivets”, page 14
- ⇒ “5.4 Symbols for Preparation”, page 15
- ⇒ “5.5 Symbols for Corrosion Protection”, page 16

5.1 Symbols for Removing Components

1 - Grinding / Grinding down to bare surface

2 - Drilling

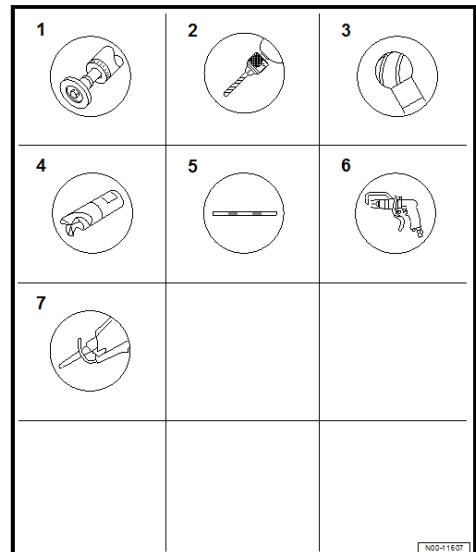
3 - Ball nose end mill

4 - BTR milling

5 - Separation Cut

6 - Loosening weld spots

7 - Sawing

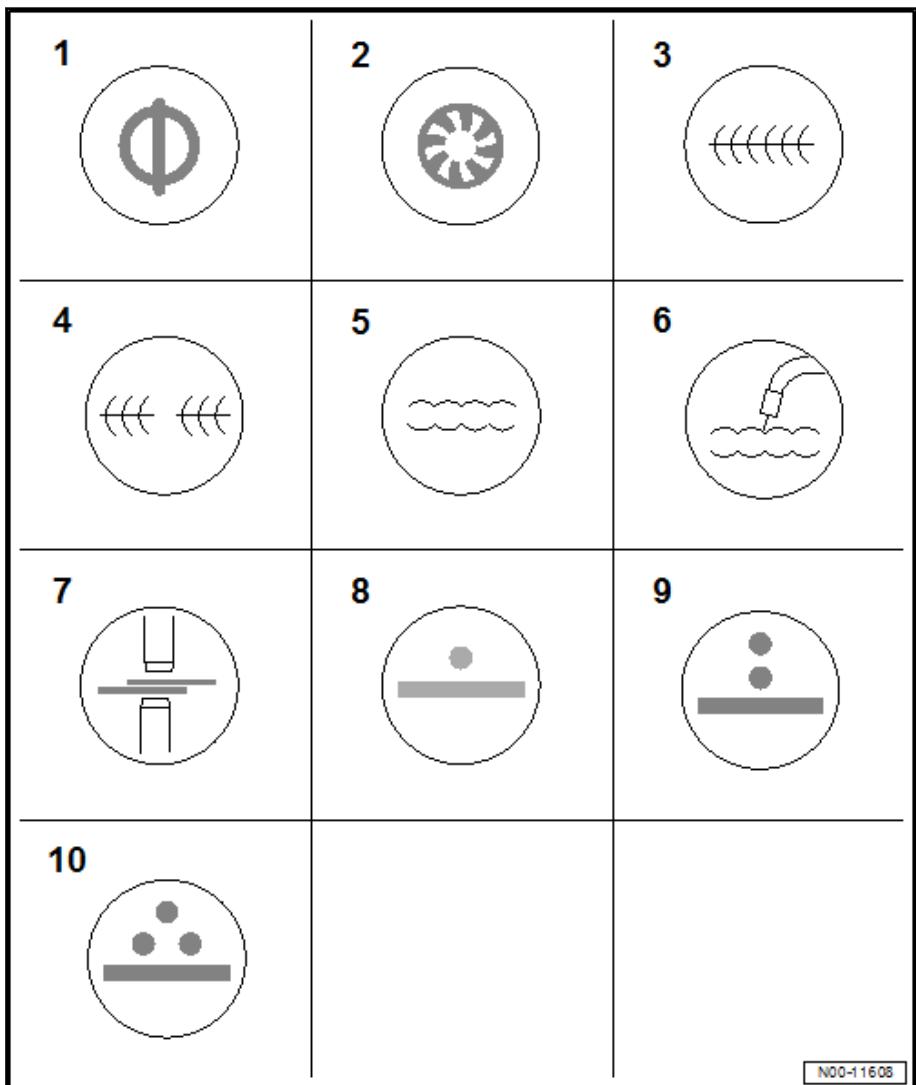


5.2 Symbols for Welding and Soldering

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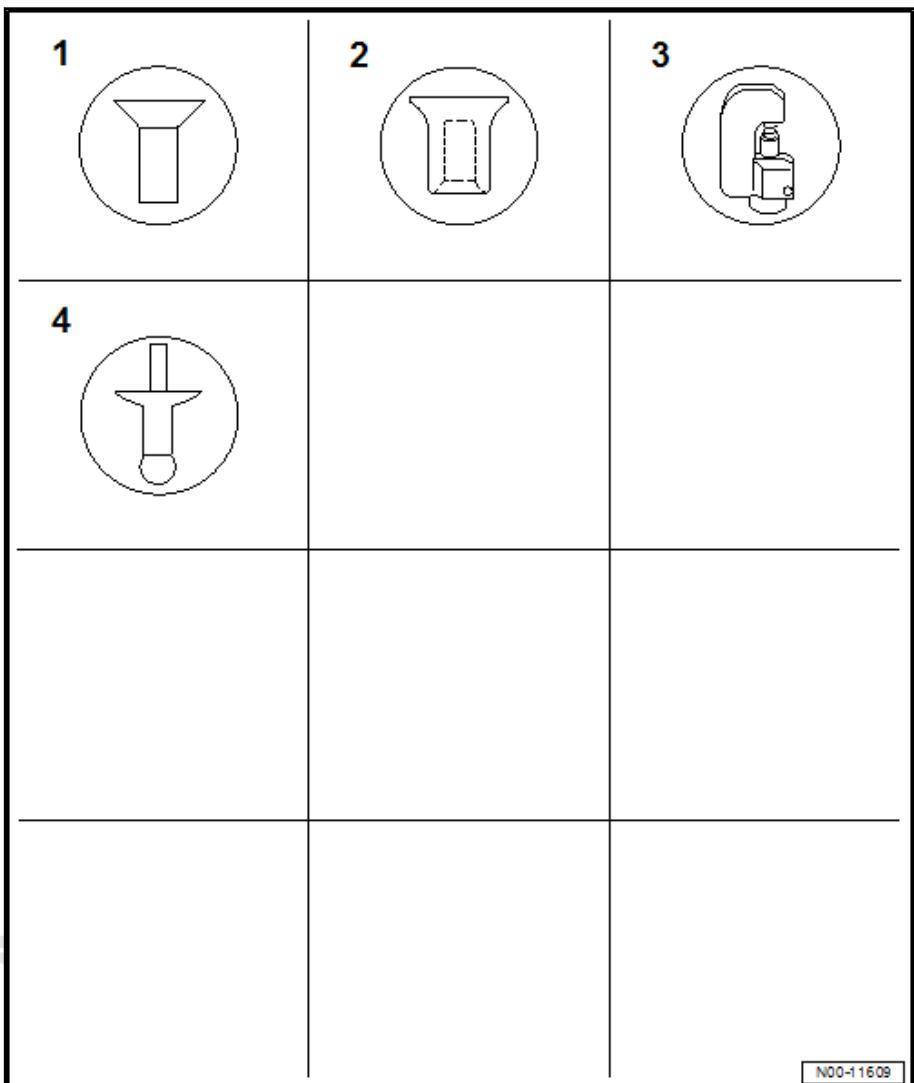


- 1 - Stitch weld seam
- 2 - Gas-shielded arc plug weld
- 3 - Gas-shielded arc continuous weld seam
- 4 - Gas-shielded arc continuous weld seam (staggered)
- 5 - Brazing
- 6 - MIG brazing
- 7 - Resistance spot welding general
- 8 - Straight-line spot weld (single row)
- 9 - Straight-line spot weld (double row)
- 10 - Straight-line spot weld (double row, staggered)



5.3 Symbols for Rivets

- 1 - Solid Rivet
- 2 - Punch rivet
- 3 - Use rivet pliers
- 4 - Pop Rivet



5.4 Symbols for Preparation

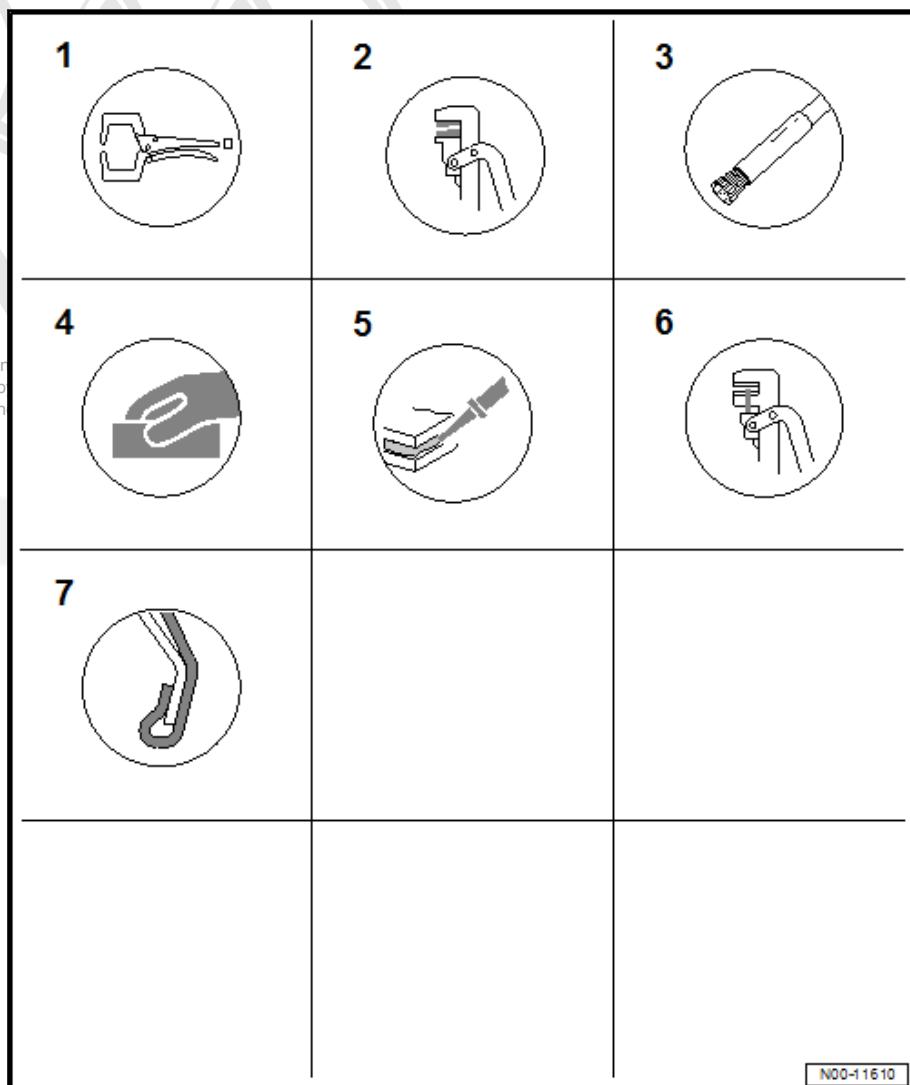
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- 1 - Clamping
- 2 - Setting
- 3 - Removing paint on hard-to-reach areas
- 4 - Sanding by hand
- 5 - Applying adhesive
- 6 - Setting
- 7 - Flanging

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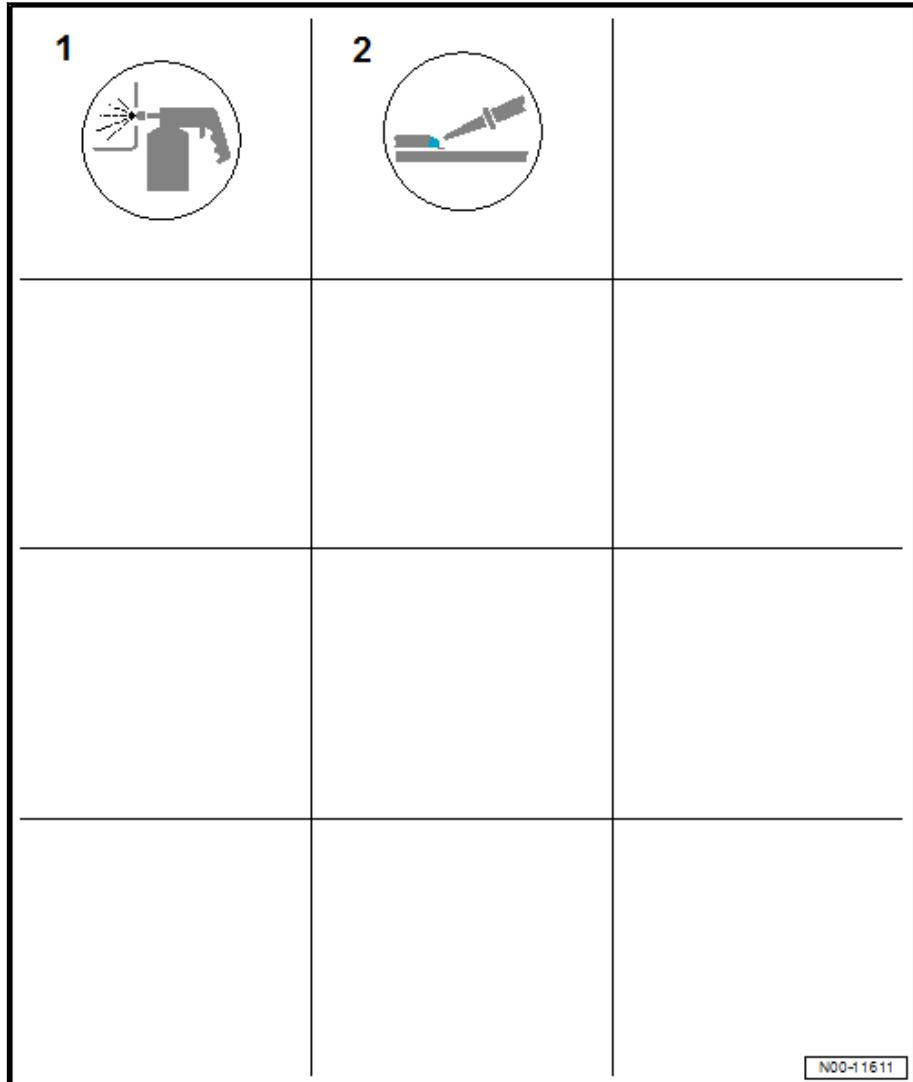


N00-11610

5.5 Symbols for Corrosion Protection

1 - Sealing Cavities

2 - Sealing



N00-11611

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6 Construction Characteristics of Vehicle Body

⇒ “6.1 Types of Body Construction”, page 18

6.1 Types of Body Construction

⇒ “6.1.1 Aluminum Spaceframe”, page 18

⇒ “6.1.2 Body-On-Frame, VW Amarok”, page 18

In addition to the familiar unitary vehicle body, other types of body construction are used in Volkswagen Group vehicles.

6.1.1 Aluminum Spaceframe

The unique characteristic of the spaceframe body is that it has a supporting frame construction made from aluminum, which ensures the stiffness of the body. Body shell components, such as roofs or fenders, also assist in this, but they generally do not have a supporting function (for example, Audi R8).

6.1.2 Body-On-Frame, VW Amarok

Vehicles with body-on-frame construction generally have a supporting ladder frame construction that carries the engine, suspension and body. This type of construction is primarily used in commercial vehicles and off-road vehicles.



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7 Damage, Evaluating

- ⇒ ["7.1 General Information", page 19](#)
- ⇒ ["7.2 Weld Seams and Cast Joints, Checking", page 19](#)
- ⇒ ["7.3 Load Paths", page 19](#)
- ⇒ ["7.4 Measuring / Damage Diagnosis", page 22](#)
- ⇒ ["7.5 Overview of Materials Used", page 23](#)
- ⇒ ["7.6 Passive Safety Systems", page 28](#)

7.1 General Information

When repairing vehicles involved in collisions, damage to the body or suspension is not discovered. In some cases, this may cause serious subsequent damage later. In accidents that indicate a heavy load on the vehicle, the following components must be checked - regardless of whether or not the axles were already checked:

- ◆ Check steering and steering linkages using steering wheel angle for problem-free function, visual inspection for bends or cracks.
- ◆ Check suspension, all suspension parts such as control arm, suspension struts, steering knuckle, stabilizer bar, subframe, axle beam and their fasteners for bends or cracks.
- ◆ Check rims and tires for damage, run-out and imbalance. Check tires for cuts in the tread and the sides and check the tire pressure.
- ◆ Check mounts for engine, transmission, axles and exhaust system for damage.
- ◆ Finally, a proper road test after repairs ensures that the vehicle is safe to drive and can be handed over to the customer.

7.2 Weld Seams and Cast Joints, Checking

The color penetration process is used to test for surface cracks. Use the approved repair materials for this.



Note

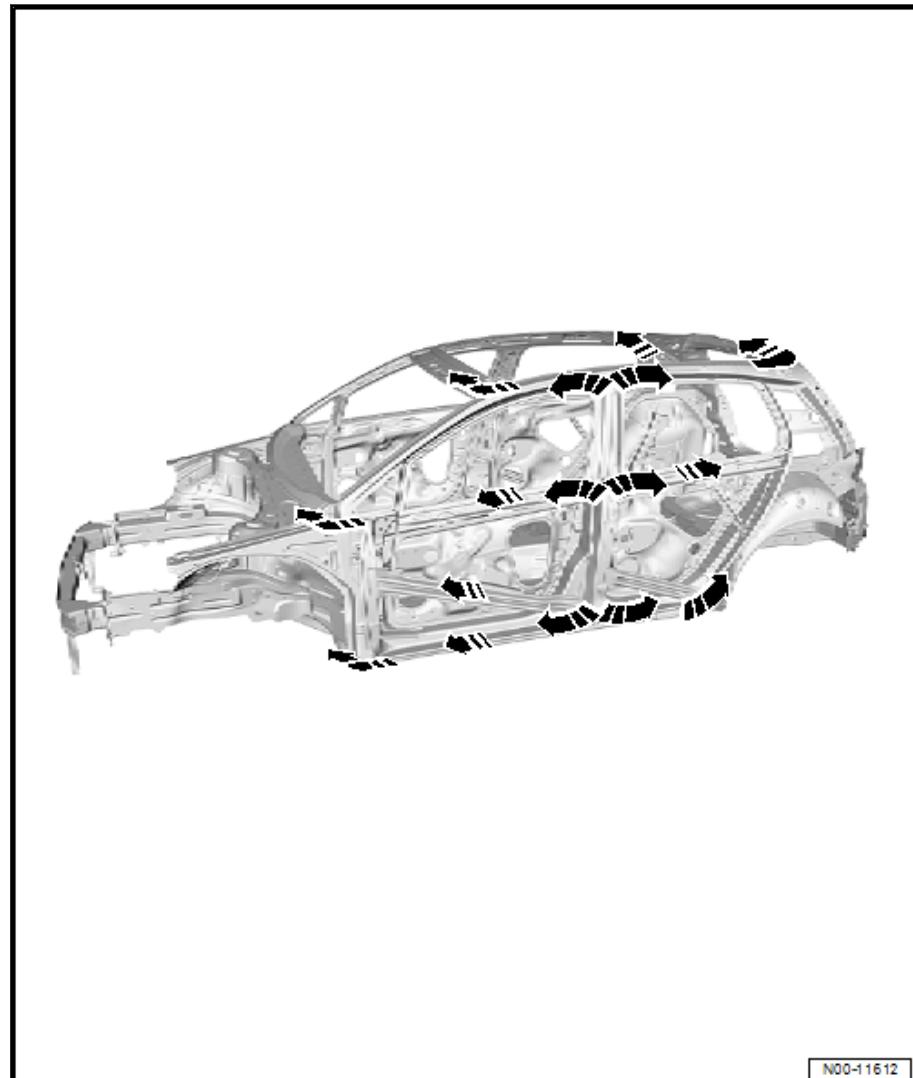
Do not brush the area to be checked before the test; otherwise, the cracks will be smeared.

7.3 Load Paths

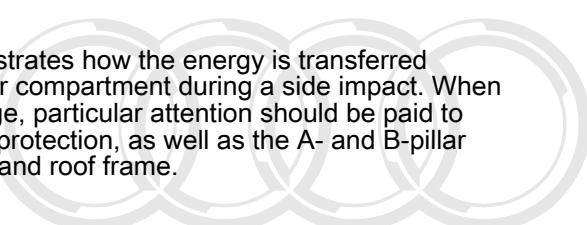


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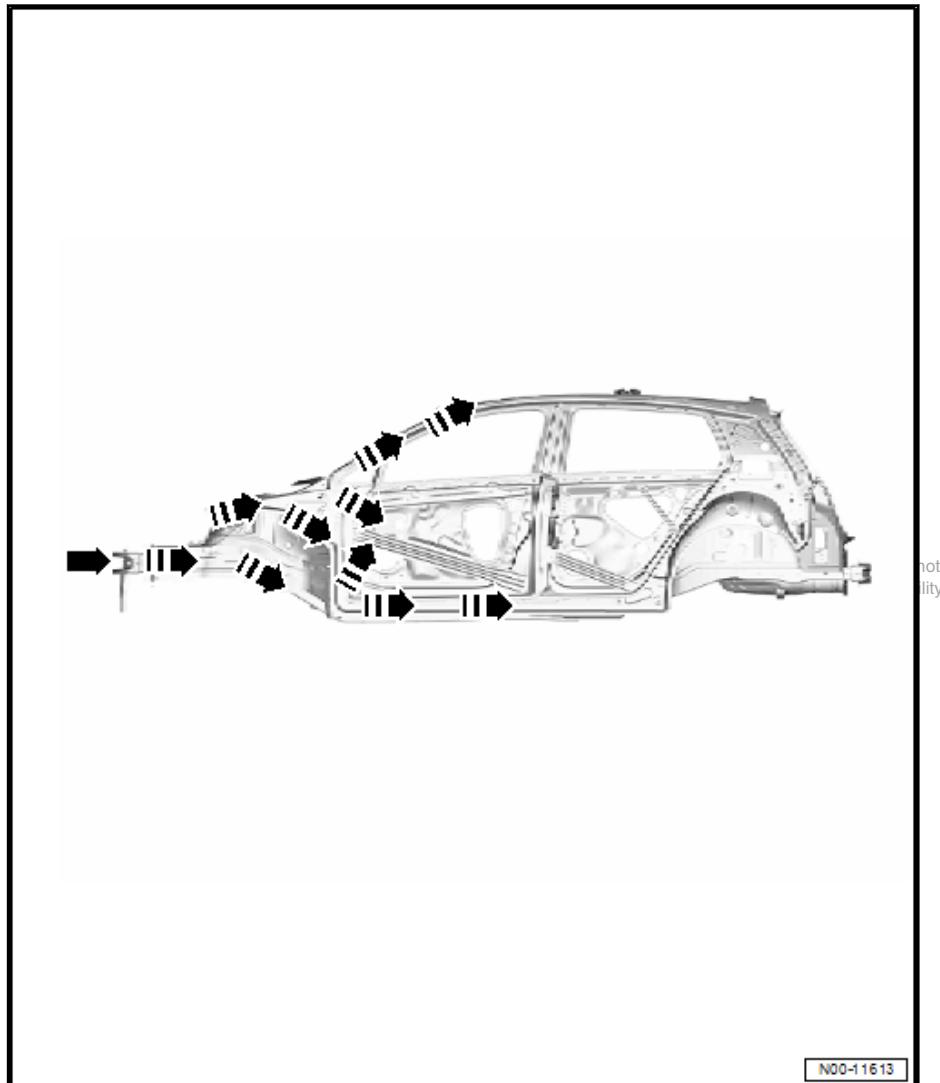
The image above illustrates how the energy is transferred around the passenger compartment during a side impact. When evaluating the damage, particular attention should be paid to the door side impact protection, as well as the A- and B-pillar connection to the sill and roof frame.



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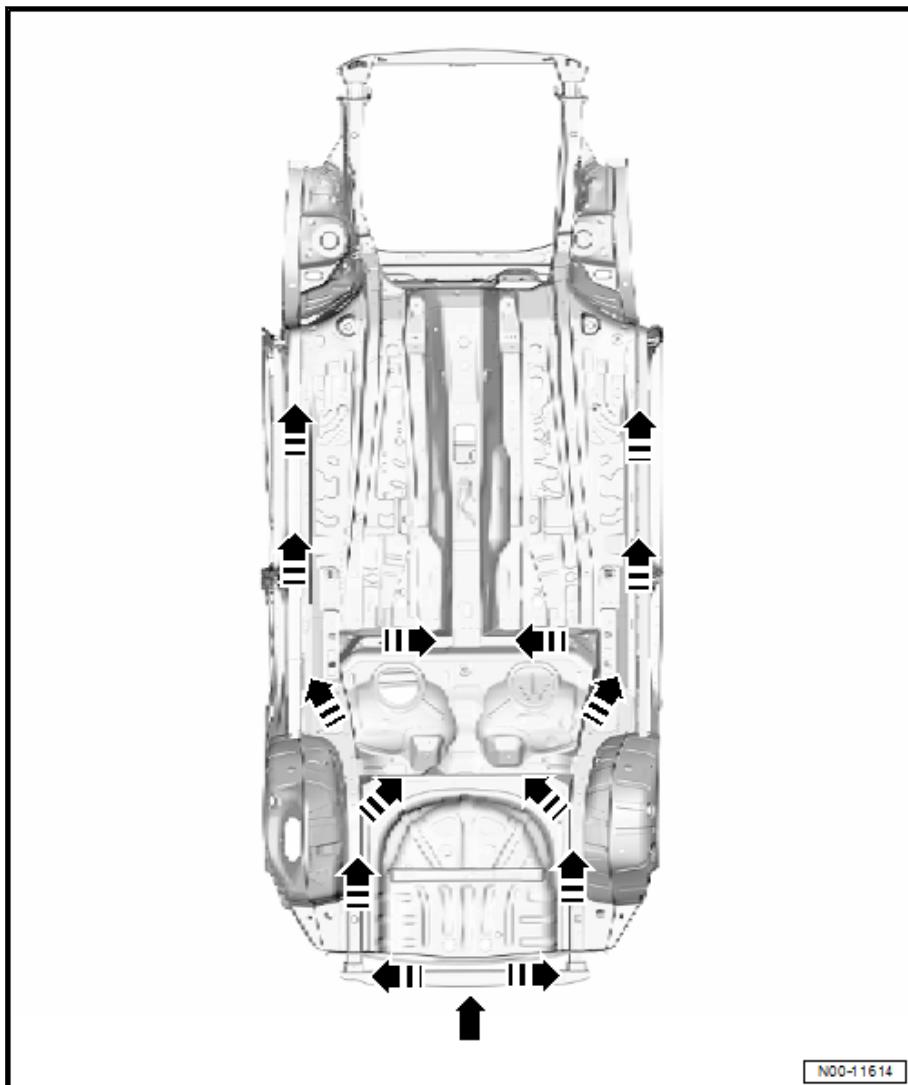




The goal of the body design is for the front of the vehicle body to absorb as much of the energy as possible.

If there is heavy damage to the front of the vehicle structure, the A-pillar transition area to the roof frame or sill must also be closely inspected during the damage evaluation.

Due to the structure, the entire outer shell should also be inspected, since elastic deformations in the high-rigidity structure may cause plastic deformations in the outer shell.



When evaluating damage in the rear, carefully inspect to see if there is any metal distortion in the luggage compartment floor area. Due to the spring effect of the materials used, there may be damage, even though the longitudinal members do not indicate any deviation in dimension.

7.4 Measuring / Damage Diagnosis

- ◆ Information on approved measuring devices can be found in the Electronic Parts Catalog (ETKA).
- ◆ For information on body and gap dimensions, refer to the vehicle-specific repair manual.

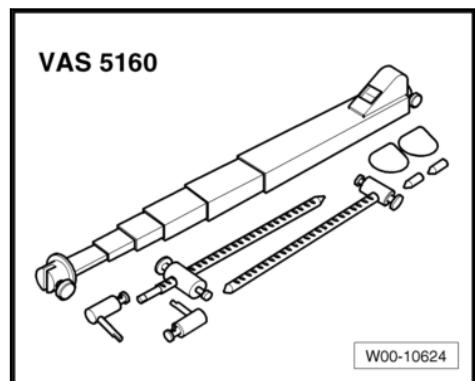
⇒ Body Repair; Rep. Gr. Body ; 00; Technical Data

Telescoping Gauge



Note

To quickly diagnose accident damage, it is often sufficient to perform a diagonal comparison measurement using a telescoping gauge.



7.5 Overview of Materials Used

- ⇒ ["7.5.1 Important Notes for Deep-Drawn Steel", page 23](#)
- ⇒ ["7.5.2 Important Notes for High-Strength and Ultra-High-Strength Steel", page 23](#)
- ⇒ ["7.5.3 Important Notes for Aluminum", page 24](#)
- ⇒ ["7.5.4 Contact Corrosion", page 25](#)
- ⇒ ["7.5.5 Important Notes for Carbon Fiber-Reinforced Polymer \(CFRP\)", page 25](#)
- ⇒ ["7.5.6 General Plastic Characteristics", page 28](#)

7.5.1 Important Notes for Deep-Drawn Steel

Body and floor assembly in series production are produced predominantly from cold-formed deep-drawing sheet metal. For this reason, reshaping accident damage should be carried out in the same way. If the size of the damage does not allow it to be reshaped against the direction of damage, the damaged part must be removed after straightening the connecting surfaces.

7.5.2 Important Notes for High-Strength and Ultra-High-Strength Steel

Reinforced (high-strength) panels are being used increasingly in our vehicles. You can see the areas where these panels are used in an image in the body repair manual.

What are high-strength panels?

Optically normal panels, but they have a higher yield point than normal body panels because of various alloys. This means, with the same force applied to the panel, the dent in the high-strength panel is not as deep as that in a normal body panel.

What must be observed when removing dents?

Dents are removed with standard tools. Due to the higher dent resistance, there is greater rebound so that it may be necessary to expend more force. When buckled areas are reshaped, breaks in the material may occur.

What must be observed when straightening with a bench-type straightening system or hydraulic press?

Due to the greater rebound characteristics of high-strength panels, it must be stretched more than a normal panel before it remains in the desired position. Due to the higher application of force, normal panels that are welded with high-strength panels are strained more. In order to prevent normal panels from yielding or tearing, an additional anchorage must be provided.

 Note

- ◆ If a high-strength panel is stretched too much, it suddenly springs back a lot unintentionally!
- ◆ For safety reasons, high-strength body panels must not be heated when reforming as with normal body panels!
- ◆ Welding high-strength steel according to the repair manual with the specified separation cuts and welding procedures is permitted.

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What are ultra-high-strength hot-formed steel panels?

They are steel panels that, as their name suggests, are formed in a warm condition at temperatures between 900 °C and 950 °C (1,652 °F and 1,742 °F). The steel panels gain their high strength through a specific cooling process in the reshaping tool. They are form hardened. The vehicle weight can be reduced without losing strength by using high-strength hot-formed steel panels. On vehicles with highest-strength hot-formed steel, spot welding devices with inverter technology (see workshop equipment and special tools catalog) are to be used.

Yield points of steel panels used:

Description	Yield points
Normal steel panel	< 160 MPa (N/mm ²)
High-strength steel panel	< 220 MPa (N/mm ²)
Extra-high-strength steel panel	< 420 MPa (N/mm ²)
Ultra-high-strength steel panel	< 1000 MPa (N/mm ²)
Ultra-high-strength hot-formed steel panel	< 1000 MPa (N/mm ²)

7.5.3 Important Notes for Aluminum

Aluminum is largely used in modern vehicle bodies to reduce weight and to increase body stiffness.

In vehicle construction, a distinction is made between:

- ◆ Aluminum sheet metal
- ◆ Aluminum extrusion profiles (may not be reformed)
- ◆ Aluminum cast parts (may not be reformed)

The properties of these components are fundamentally different. If there is damage, pay attention to the vehicle-specific repair manuals.

 Note

- ◆ The following instructions only apply to conventional steel vehicles on which aluminum metal parts are installed.
- ◆ You can see the areas where these panels are used in an image in the respective body repair manual.

 Note

- ◆ Use tools for either steel or aluminum.
- ◆ Recommendation: special aluminum tool kit in tool cart

7.5.4 Contact Corrosion

Contact corrosion may occur if unsuitable connecting elements (bolts, nuts, washers and etc.) are used. For this reason, only fasteners with a special surface coating may be installed. In addition, rubber and plastic parts and adhesive are made of non-conductive materials. If there is any doubt as to whether parts should be reused, always install new parts.



Note

- ◆ *Only use original replacement parts. They have been checked and are compatible with aluminum.*
- ◆ *Accessories must be approved by Volkswagen AG.*
- ◆ *If unapproved materials are used, contact corrosion damage is not covered under warranty.*

7.5.5 Important Notes for Carbon Fiber-Rein-

**Important Notes for Carbon Insertion
forced Polymer (CFRP)**



Note

Work on the carbon fiber reinforced polymer (CFRP) areas should only be done by qualified personal.

Occupational Safety

When working on CFRP components make sure there is enough protective equipment.

Evacuation must be used. Acceleration of work by raising the parameters can pose a health risk, when vapors, smoke or dust result.

Personal protective equipment must be used.

- 1 - Safety Gloves
- 2 - Protective Eyewear
- 3 - Protective Apron
- 4 - Mask

 **Note**

- ◆ Only specially qualified technicians may perform procedures that handle carbon fiber-reinforced polymer (CFRP).
- ◆ Drilling, sawing, grinding, cutting or any other machining procedures are not permitted on carbon fiber-reinforced polymer (CFRP) components.
- ◆ Carbon fiber-reinforced polymer (CFRP) is electrically conductive. However it is not permitted to establish a ground connection through carbon fiber-reinforced polymer (CFRP).
- ◆ When working on current-carrying wires, every contact with carbon fiber-reinforced polymer (CFRP) components must be disabled (risk of short circuit).
- ◆ When repairing the vehicle and during removal and installation of assemblies for example, every hard contact with carbon fiber-reinforced polymer (CFRP) components must be avoided (risk of invisible damage to the carbon fiber-reinforced polymer (CFRP) structure).
- ◆ When working on the body, only materials approved by the manufacturer may be used, such as primer, adhesive and rivets.
- ◆ When working on the body, only procedures approved by the manufacturer may be implemented.

Carbon fiber-reinforced polymer (CFRP) properties:

CFRP is an abbreviation for carbon fiber-reinforced polymer.

Fiber diameter = approximately 6µm

Specific weight = 1.8g (0.1 oz)/cm³

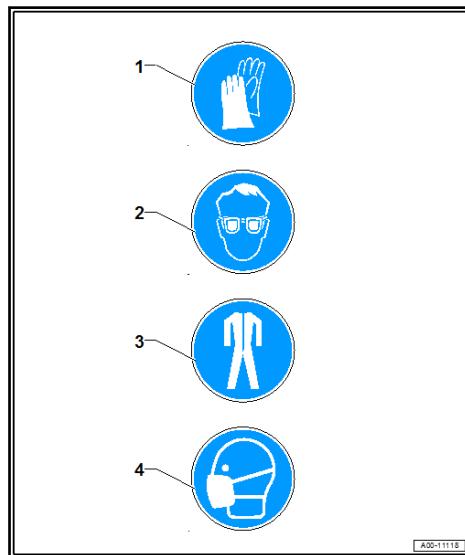
Tensile strength = 3530 — 4560 Mpa

Elongation = 1.1 — 1.5 %

Between 1,000 and 24,000 individual fibers are combined into bundles for weaving.

Advantages of carbon fiber-reinforced polymer (CFRP) components

- ◆ Extremely light: approximately 60% weight saving as compared to steel, approximately 30% as compared to aluminum.
- ◆ Highest stability: approximately four times more resilient than aluminum.
- ◆ 100 % corrosion-resistant.
- ◆ Gas- and pressure-tight.
- ◆ High long-term heat resistance.



- ◆ Hardly measurable thermal expansion

Disadvantages of carbon fiber-reinforced polymer (CFRP) components

- ◆ Very expensive material.
- ◆ Difficulty evaluating material if damaged. Damage, such as cracks that are not visible to the human eye, require the use of thermal imaging, infrared and X-ray procedures.
- ◆ Repairing structure-relevant carbon fiber-reinforced polymer (CFRP) components is generally not permitted; components must be replaced.

Special notes on using carbon fiber reinforced polymer (CFRP) in production vehicles:

When used in vehicles, the properties must be carefully considered with regard to widespread maintenance servicing by workshops. CFRP components forgive damage less than metal. If a component is damaged it must be replaced. To prevent damage to the remaining components in the vehicle, do not use force or large amounts of strength. Use the specified tools. Pay close attention to the procedure and parameters, as they ensure damage-free work. Patience and care for this work is of the utmost importance.

Not all carbon fiber-reinforced polymer (CFRP) is the same.

Unlike metals the characteristics of CFRP material are not generally visible. The characteristics are example specific. Depending on the resin, fibers, fiber direction and many other factors the components behavior is independent.

Deformation behavior

CFRP components can be constructed so that they displace energy. As a result, they burst or they secure the safety cell during a collision. They can be designed to be deformable from the construction. It is very important to pay attention to and follow the instructions for each component.

Elasticity after application of force

A CFRP component can be deformed through the load, show breaks or inner damage. After removal of the load a spring back is possible. If this is the case an evaluation of the component is very critical, when this has to do with inner components.

Detecting damage

Cracks, scratches and fiber breakage can be assessed from the outside. When the rear side is visible, impact damage can be partly determined. A delamination (layer separation) that may have occurred through an impact reduces the component strength, the bending strength and thus the breaking and component rigidity of the laminate. Because it is not possible to evaluate the damage of CFRP components based solely on a visual inspection and the properties of the components can be drastically worsened by slight damage, it is extremely important to conduct a careful inspection before a damage diagnosis is made.

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Overview of nondestructive inspection methods

- ◆ Radiography = computed tomography (CT)
- ◆ Acoustic = ultrasound, knock test
- ◆ Visual = shearography
- ◆ Thermal = thermography
- ◆ Electrical / magnetic = eddy current testing

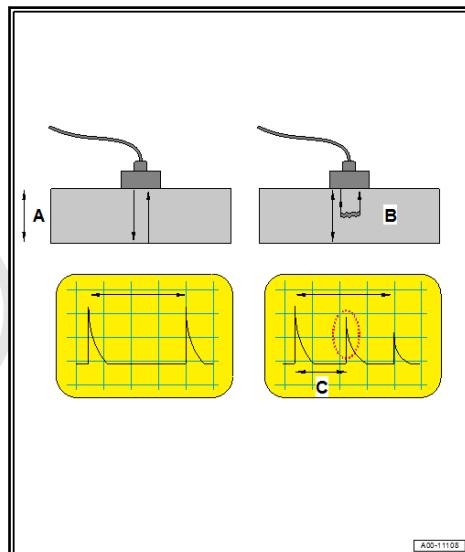
Audi AG uses the ultrasonic method for diagnosing carbon fiber-reinforced polymer (CFRP) components.

The test sends ultrasonic sound pulses with a very short duration (1-10 µs) that pass through the test component. The sound pulses are reflected by the rear wall and return to the test probe as an echo. Compare the data with the data of a malfunction free part

A - Material thickness

B - Error in component

C - Error depth



7.5.6 General Plastic Characteristics

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The areas where plastics are used are very diverse. Information about properties and the repair itself can be found in the vehicle-specific repair manual, or in the chapter: Refer to ⇒ "16 Plastic Repair", page 82 .

7.6 Passive Safety Systems

- ⇒ "7.6.1 Restraint Systems (Seat Belt Systems)", page 28
- ⇒ "7.6.2 Belt Tensioners, Safety Precautions", page 29
- ⇒ "7.6.3 Working on Vehicles With Belt Tensioners", page 29
- ⇒ "7.6.4 Disposal of Undeployed Pyrotechnic Components", page 30
- ⇒ "7.6.5 Restraint Systems (Airbag Systems)", page 30
- ⇒ "7.6.6 Important Notes when Working on Seats with Side Airbag", page 31
- ⇒ "7.6.7 Instructions for Disposal", page 31

7.6.1 Restraint Systems (Seat Belt Systems)

Check points:

- Check the seat belt webbing. Refer to ⇒ Body Interior; Rep. Gr. 00 ; Safety Precautions; Seat Belt Webbing, Checking .
- Check the belt retractor (locking function). Refer to ⇒ Body Interior; Rep. Gr. 00 ; Safety Precautions; Automatic Belt Retractor (Locking Function), Checking .
- Visually inspect the seat belt latch. Refer to ⇒ Body Interior; Rep. Gr. 00 ; Safety Precautions; Seat Belt Latch, Visually Inspecting .
- Check the function of the seat belt latch. Refer to ⇒ Body Interior; Rep. Gr. 00 ; Safety Precautions; Seat Belt Latch, Checking Function .
- Check the seat belt relays and the belt tongue. Refer to ⇒ Body Interior; Rep. Gr. 00 ; Safety Precautions; Seat Belt Relays and Belt Tongue, Checking .
- Check the fasteners and mounting points. Refer to ⇒ Body Interior; Rep. Gr. 00 ; Safety Precautions; Fasteners and Mounting Points, Checking after Collision .



Note

If customer refuses to have a damaged seat belt replaced, appropriate note should be made.

7.6.2 Belt Tensioners, Safety Precautions

- ◆ Testing, assembly, and repair work may only be performed by qualified personnel.
- ◆ The pyrotechnic propellant has no expiration date, this means it has an unlimited service life and is maintenance-free.
- ◆ Belt tensioner components may not be opened or repaired; always use new parts.
- ◆ Belt tensioner units which have fallen to the ground must no longer be installed in the vehicle.
- ◆ Belt tensioner units that are mechanically damaged (dents, cracks) must always be replaced.
- ◆ Belt tensioner units should be installed immediately after removing them from the shipping package.
- ◆ **The belt tensioner unit is to be returned to shipping package when work is interrupted.**
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- ◆ It is not permitted to leave the belt tensioner unit unattended.
- ◆ The belt tensioner unit may not be treated with lubricant, cleaning agents, or similar materials, and may not be exposed, even briefly, to temperatures above 100 °C (212 °F).

7.6.3 Working on Vehicles With Belt Tensioners



Note

Before beginning separation work, straightening work and/or dent removal, remove mechanically activating belt tensioners without load detection (release lock). With electrically activating belt tensioners, the battery ground cable must be disconnected.



Note

If the belt webbing is completely unrolled, the load detection (release lock) hinders the release of the mechanically activated belt tensioner in an accident.

 Note

- ◆ *With belt tensioners with load detection, the belt webbing must not be pulled out when performing separation work, straightening work and/or dent removal. If strong vibrations are generated by separating work, straightening work or dent removal, the belt tensioners with load detection must be removed.*
- ◆ *Information can be found in the vehicle-specific repair manuals. Refer to ⇒ Body Interior; Rep. Gr. 69 ; Passenger Protection; Seat Belts .*

7.6.4 Disposal of Undeployed Pyrotechnic Components

- ◆ Airbags,
- ◆ Seat belts,
- ◆ Pyrotechnic battery cut-out elements
- ◆ Active front lid release unit

These must be returned in their original packaging for proper recycling/disposal in accordance with national regulations. If there are any questions, contact the distributor or importer.

 Note

Pyrotechnic components deployed in an actual accident can be disposed of as industrial waste.

 Note

- ◆ *This does not apply to seat belt tensioner that function according to the "Wankel tensioner principle".*
- ◆ *These should be handled like undeployed pyrotechnic components, because they cannot be checked using service equipment if all pyrotechnic materials have deployed.*

7.6.5 Restraint Systems (Airbag Systems)

Refer to the vehicle-specific repair manuals for all procedures on the airbag systems. Refer to ⇒ Body Interior; Rep. Gr. 69 ; Airbag System; Component Location Overview - Airbag System as well as the corresponding safety precautions in ⇒ Body Interior; Rep. Gr. 00 ; Safety Precautions; Safety Precautions when Working on Pyrotechnic Components .



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 Note

- ◆ *The battery ground cable must be disconnected when working on the airbag system or when performing alignment work during body repairs.*
- ◆ *Switch off ignition before connecting battery!*
- ◆ *There should not be any people inside the vehicle when connecting the battery!*
- ◆ *Airbag components must not be exposed to temperatures over 100 °C (212 °F), even if for a short period of time.*
- ◆ *Airbag components must not come in contact with grease, cleaning materials, oil, or similar substances.*
- ◆ *Mechanically damaged airbag components must be replaced.*
- ◆ *Wash hands after touching deployed airbag units.*

7.6.6 Important Notes when Working on Seats with Side Airbag

 Note

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- ◆ *The safety precautions must always be followed when removing the seats.*

7.6.7 Instructions for Disposal

Refer to ⇒ Body Interior; Rep. Gr. 00 ; Safety precautions; Storage, Transport, and Disposal of Airbag, Seat Belt Tensioner, and Battery Cut-Out Units (Pyrotechnic Components) .

8 Thermal Joining Techniques

- ⇒ “8.1 Resistance Spot Welding”, page 32
- ⇒ “8.2 Gas-Shielded Plug Welding”, page 33
- ⇒ “8.3 Gas-Shielded Arc Continuous and Stitch Weld Seams”, page 34
- ⇒ “8.4 MIG Soldering”, page 34
- ⇒ “8.5 Aluminum Welding”, page 34
- ⇒ “8.6 Laser Welds”, page 35
- ⇒ “8.7 Laser Soldering”, page 35
- ⇒ “8.8 Replacement Joining Procedures in Repair (Steel)”, page 36
- ⇒ “8.9 Replacement Joining Procedures in Repair (Aluminum)”, page 36

The thermal joining techniques currently used in body repair procedures are presented in the following chapter.

8.1 Resistance Spot Welding

The basic principle for repair welding is to re-create as much of the original welded connection as possible.

This requires that:

- ◆ The panels to be welded overlap.
- ◆ Both sides of the weld point are accessible to the electrodes.
- ◆ The resistance spot welder is strong enough to produce weld spot diameters like at the factory.

During body repair work, access to weld points varies. Therefore, each resistance spot welder must have a complete set of the most common types of electrodes.

Zinc-Coated Panels, Straight-Line Welding

When performing resistance spot welding on zinc-coated panels, observe following points:

- ◆ The flanges to be spot welded must touch. If necessary, tension the flanges with pliers.
- ◆ This is especially important with high-strength panels because the electrode strength is not great enough.
- ◆ Do not weld directly by the clamping pliers with the welding tongs because a large amount of the welding current flows through here due to shunting.
- ◆ With small spot weld spacing, weld points in a sequential order or weld every third point to secure, then finish welding. This minimizes the shunting influence.
- ◆ Observe Owner's Manual and adjustment notes from manufacturer.



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Devices

Only the devices approved in the Workshop Equipment Catalog may be used.

Test Button Weld

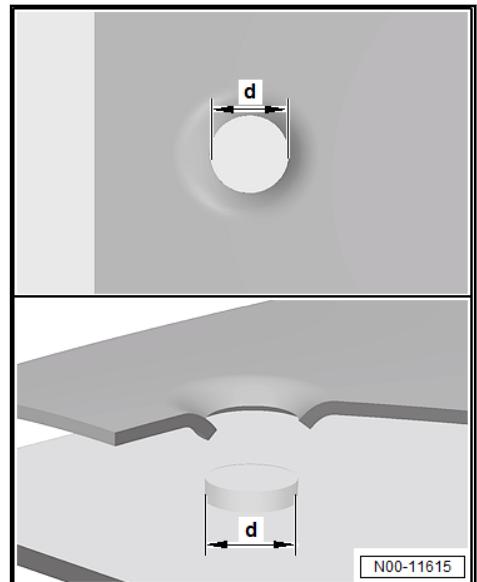
- For the necessary button weld diameter, determine the panel pairing based on the manufacturer's specifications and check with test panels.
- Check all spot weld connections 100% with a chisel test.
- Qualitatively acceptable spot welds do not tear into the contact surface, but rather "unbutton".
- Calculate the button weld diameter with the following formula and check on test panels before beginning repair.

Square root of $T_1^*3,5^*1,15$



Note

T_1 is the thinnest panel in a panel combination, for example, panel combination of 1.5 mm and 0.8 mm. Example calculation: root of $0.8 \times 3.5 \times 1.15 = 3.6$ mm button weld diameter. With the test, the small welded test strip is rolled or pulled from the second test strip with force perpendicular to the panel surface.



N00-11615

Devices

Only the devices approved in the Workshop Equipment Catalog may be used.

8.2 Gas-Shielded Plug Welding

Gas-shielded plug welding is mostly used when the standard implemented resistance spots cannot be recreated, for example due to limited accessibility.

Always refer to the vehicle-specific repair manuals for this.

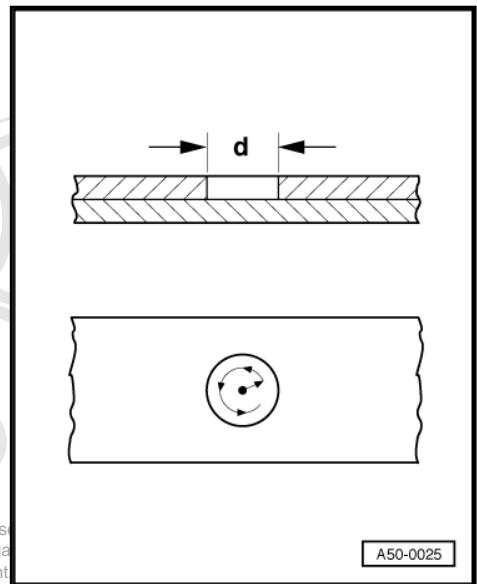
General Information regarding Gas-Shielded Plug Welding

- ◆ Loosen weld spots with spot weld cutter or sand off.
- ◆ Remove the damaged part, separate with a chisel if necessary.
- ◆ Sand down projections.
- ◆ Adapt the new part.
- ◆ Drill the top panel for plug welding (refer to the vehicle-specific repair manual for the drill bit diameter).
- ◆ Clean the flanges and remove the oxide coating.
- ◆ Perform plug welding from center outward.



Note

Riveting are also permitted, to some extent. Observe the body repair repair manual.



A50-0025

Devices

Only the devices approved in the Workshop Equipment Catalog may be used.

8.3 Gas-Shielded Arc Continuous and Stitch Weld Seams

Gas-shielded arc continuous and stitch weld seams are primarily used when joining butt-welded or overlapping separating points. Due to the very high welding temperatures and the altered material properties associated with it, there is increasingly limited use of this joining process. Always refer to the vehicle-specific repair manuals for this.

The weld seams may not be sanded otherwise the strength of the weld seam will be impaired.

Devices

Only the devices approved in the Workshop Equipment Catalog may be used.

8.4 MIG Soldering

MIG soldering primarily differs from the gas-shielded arc stitch or continuous weld seam in that it requires significantly lower temperatures. The advantage of MIG soldering is a significant reduction in material distortion in the components being connected. The joining process is also suitable for larger flat components.

Other advantages include:

- ◆ Minimal structural changes in the components.
- ◆ Minimal damage to the corrosion protection applied during production.
- ◆ Preserves the zinc coating on the components.

What is MIG soldering? (not approved for AUDI AG vehicles)

- ◆ Brazing procedures are also called gas-shielded metal soldering.
- ◆ The base material (body panel) is not melted on; the solder coats the flanks and connects the components.
- ◆ MIG stands for metal inert gas. The inert gases are not actively involved in the processes between the electric arc and welding filler material.
- ◆ Argon or helium are among the inert gases to be used, and are mixed with carbon dioxide or oxygen.
- ◆ Up to 450 °C: solder
- ◆ From 450 °C: braze

Devices

Only the devices approved in the Workshop Equipment Catalog may be used.

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8.5 Aluminum Welding

Metal Inert Gas (MIG) welding is used by the manufacturer and in service.

Argon is used as inert gas.

- Before welding, remove any underbody protection and paint from the components.
- Then remove the approximately 40 mm of the oxide layer on both sides using a stainless steel brush.
- To avoid formation of cracks, weld seams must be drawn around section corners.



Note

- ◆ Use the Panel - 4D0 898 103- for welding practice and repairs.
- ◆ Additional information can be found in the "aluminum welding" training guide.

Same Material, Underlying

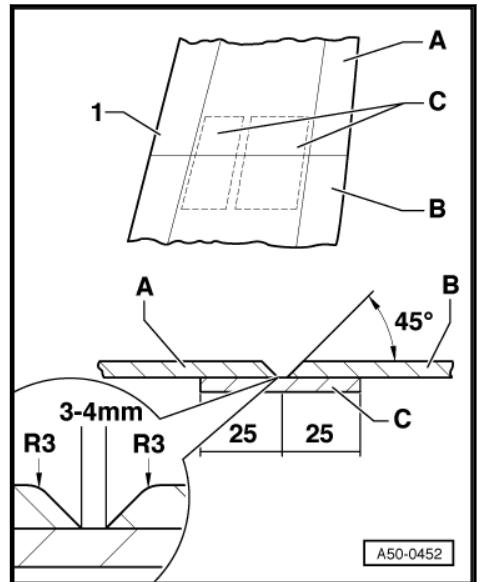
Same material -C- is created from remainder of new -B- or old parts -A-. Same material should also be underlaid on beaded panel edges. On small cross sections or large panel edges, the same material is separated.

- Bevel both panels 45°. Round outer edge (radius = 3) and chamfer inner edge.

Panel tips must be 3 to 4 mm apart.

Devices

Only the devices approved in the Workshop Equipment Catalog may be used.



8.6 Laser Welds

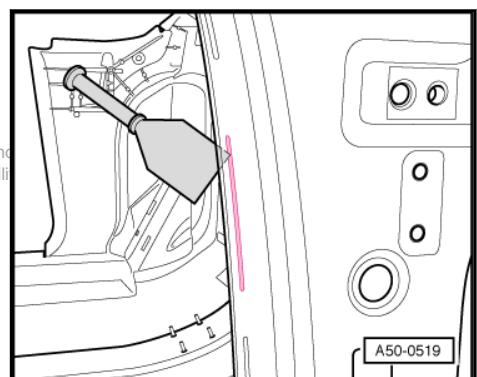


This joining procedure is only used during manufacture.

Information on the replacement procedures can be found in the following chapter overviews. Refer to ["8.8 Replacement Joining Procedures in Repair \(Steel\)"](#), page 36 or Refer to ["8.9 Replacement Joining Procedures in Repair \(Aluminum\)"](#), page 36 .

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In laser welding, a high-energy light beam is directed onto the weld point via optical lenses or fiber optics. During the welding process, the upper panel is melted through and as well as with the lower panel on the surface, thereby forming a weld without using any additional materials.



8.7 Laser Soldering



This joining procedure is only used during manufacture.

Information on the replacement procedures can be found in the following chapter overviews. Refer to ["8.8 Replacement Joining Procedures in Repair \(Steel\)"](#), page 36 or Refer to ["8.9 Replacement Joining Procedures in Repair \(Aluminum\)"](#), page 36 .

Always refer to the vehicle-specific repair manuals for this.

Generally, an additional material is used during laser soldering. The soldered connection is not fundamentally different than that of an MIG soldered connection.

Only the fusing of additional material does not occur using electric arc, but rather using a concentrated light beam the as for laser welding. Due to the laser technology, the energy can be applied at a precise point. Undesirable side effects, such as heat distortion, are negligible.

8.8 Replacement Joining Procedures in Repair (Steel)

In production	In repair
Spot welds	Spot weld bonding / MAG plug welding / MAG welding
MAG Welding	MAG Welding
MIG Soldering	MAG Welding
Laser Welds	MAG Welding
Laser Soldering	MIG soldering (not approved for AUDI AG vehicles) Bonding MAG welding Note the information in the repair manual
Bonding	Bonding / MAG welding
Spot weld bonding	Bonding with spot welding / additional spot welds / additional MAG welding
Pop rivets	Pop rivets Only use pop rivets specified in the repair manual. <small>Protected by copyright. Copying, in part or in whole, is not permitted unless authorised by AUDI AG. Commercial purposes, in part or in whole, is not permitted unless authorised by AUDI AG. With respect to the correctness of the information in this document, Copyright by AUDI AG.</small> Commercially available pop rivets generally do not have sufficient strength.

8.9 Replacement Joining Procedures in Repair (Aluminum)

In production	In repair
MIG welding	MIG welding
Spot welds	Not used
MIG Soldering	Not used
Laser Welds	Bonding and riveting
Bonding	Bonding and riveting
Punch rivets	Punch rivets
Pop rivets	Pop rivets Only use pop rivets specified in the repair manual. Commercially available pop rivets generally do not have sufficient strength.

9 Body Structural Adhesive D 180 004 M2, Application

⇒ ["9.1 Adhesive Surfaces, Preparing", page 38](#)

Bonded Joints, Detaching

Body bonded joints can be detached by applying heat. The adhesives used in the vehicle construction and the repair are destroyed at temperatures 180 – 200°C (392 °F).



Note

- ◆ *Wear protective gloves and eyewear.*
- ◆ *Avoid direct contact of the adhesives with the skin.*
- ◆ *Avoid inhaling solvent vapors.*
- ◆ *Only process adhesives in well-ventilated areas.*
- ◆ *Always note the hazard information from the manufacturer.*
- ◆ *Also note the accident prevention regulations applicable in the respective country.*
- ◆ *Note the corresponding safety data sheets for the adhesive.*
- ◆ *Do not smoke, eat or drink at the work station.*
- ◆ *Use suitable extraction.*
- The vehicle, parts and adhesive materials must be at processing temperature (acclimated). The processing temperature must be kept for 30 min before work on the adhesive surfaces starts.
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- The adhesive surfaces must be free of oils, adhesive residue, humidity, paint and oxide coatings.
- Body structural adhesive must only be used on bare metal components.
- Only use sanding material based on silicon carbide (SIC) for grinding down the adhesive surface.
- Pay attention that the cleaned surfaces are only touched with clean gloves in order to avoid transferring hand sweat or contamination to the adhesive surface.
- Merging must happen immediately after applying the adhesive, in order to ensure a high-quality and secure bonding. Otherwise the adhesive bead must be removed and the surface treatment and application of the adhesive must be repeated.
- Carefully prime the accessible adhesion areas after hardening and seal them with body sealant. Protect adhesion areas in cavities against corrosion using cavity sealant.

 Note

- ◆ *Use the adhesive material within the processing time. Within this time frame the adhesive material must be applied and connected to the body component. Any resistance weld spots or mechanical joining processes (for example rivets and bolts) in the area of the adhesive must be performed within this time frame.*
- ◆ *Do not stress bonded parts until hardened!*

 Note

During colder seasons, over night or in countries with a cold climate, suitable measures must be taken to reach the minimum hardening temperature.

- Optimize the controls of the heating system, for example deactivate reducing temperatures at night.
- Keep doors and windows closed, and prevent drafts.
- Install auxiliary heaters in the area of the body repair.
- In addition to these guidelines, mind the respective procedure descriptions for body repairs!

9.1 Adhesive Surfaces, Preparing

[⇒ “9.1.1 Joining Process”, page 42](#)

[⇒ “9.1.2 Hardening”, page 47](#)

[⇒ “9.1.3 Assembling Stability”, page 48](#)

[⇒ “9.1.4 Corrosion Protection”, page 48](#)

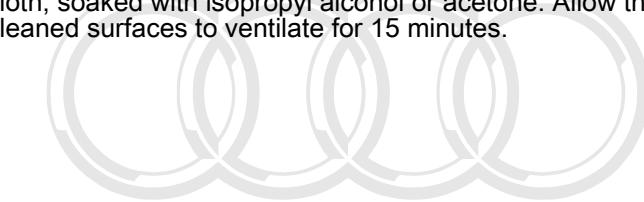
[⇒ “9.1.5 Work Sample”, page 49](#)

Pre cleaning

Remove solid layers like dirt, rust, paint coats (CDC).

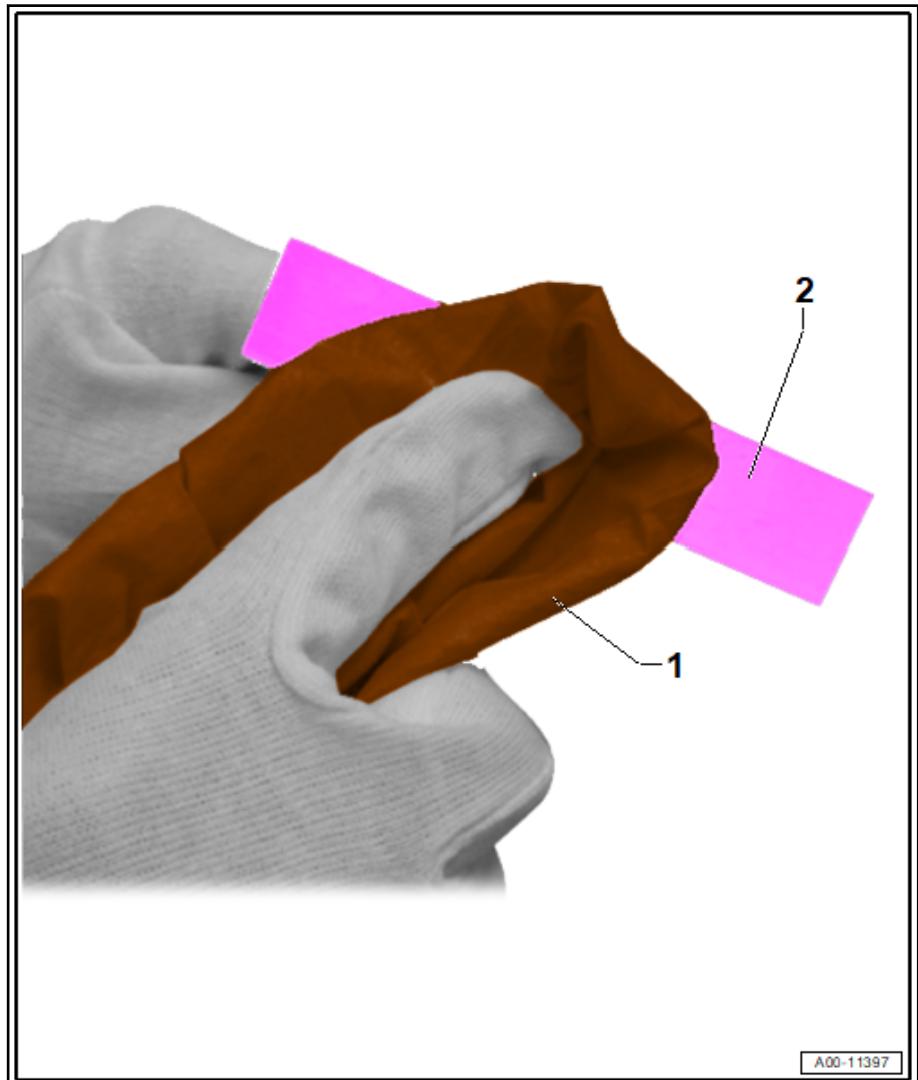
Cleaning

- To prevent spreading possible grease residue when grinding down afterwards, clean the adhesive surfaces with a lint-free cloth, soaked with isopropyl alcohol or acetone. Allow the cleaned surfaces to ventilate for 15 minutes.



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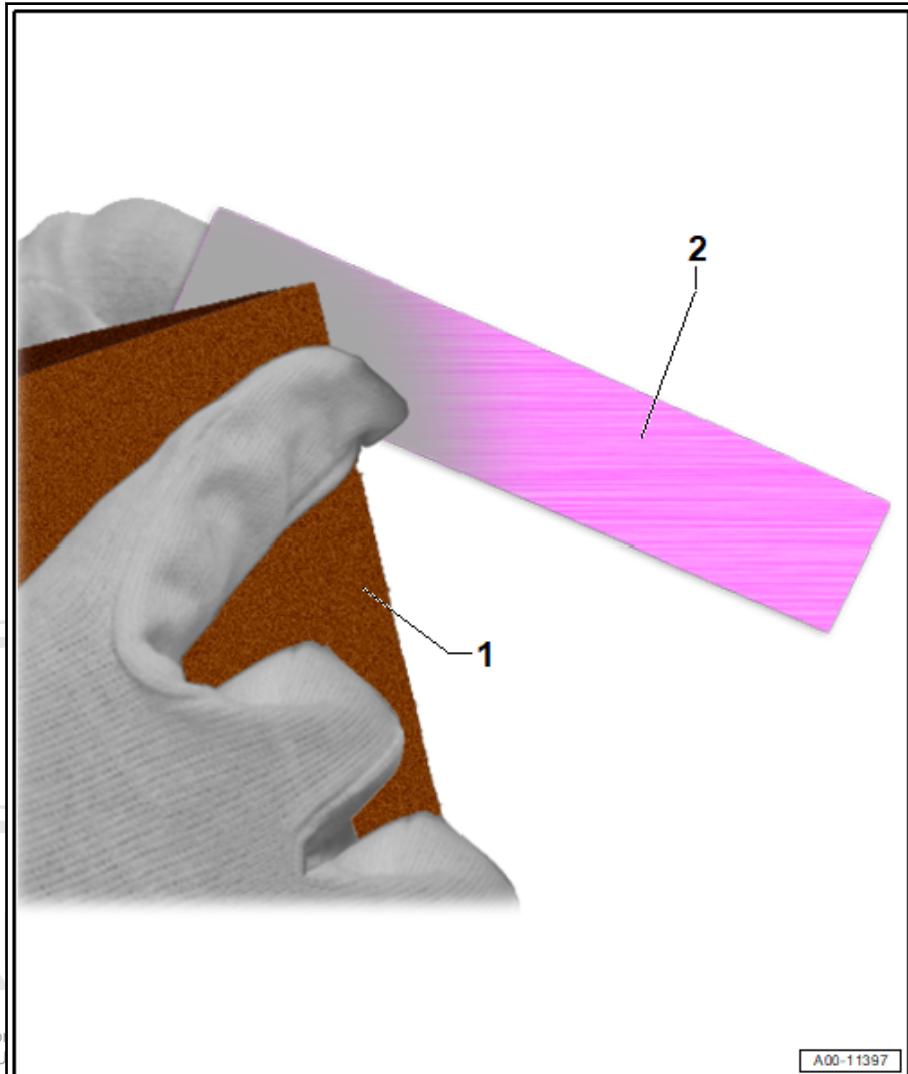


Grinding down

To improve adhesion, grind down the adhesive surfaces with grid 150 to 180 sandpaper. Use crossover gridding process.

Only use sanding material based on silicon carbide (SIC) for grinding down the adhesive surface.

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Cleaning

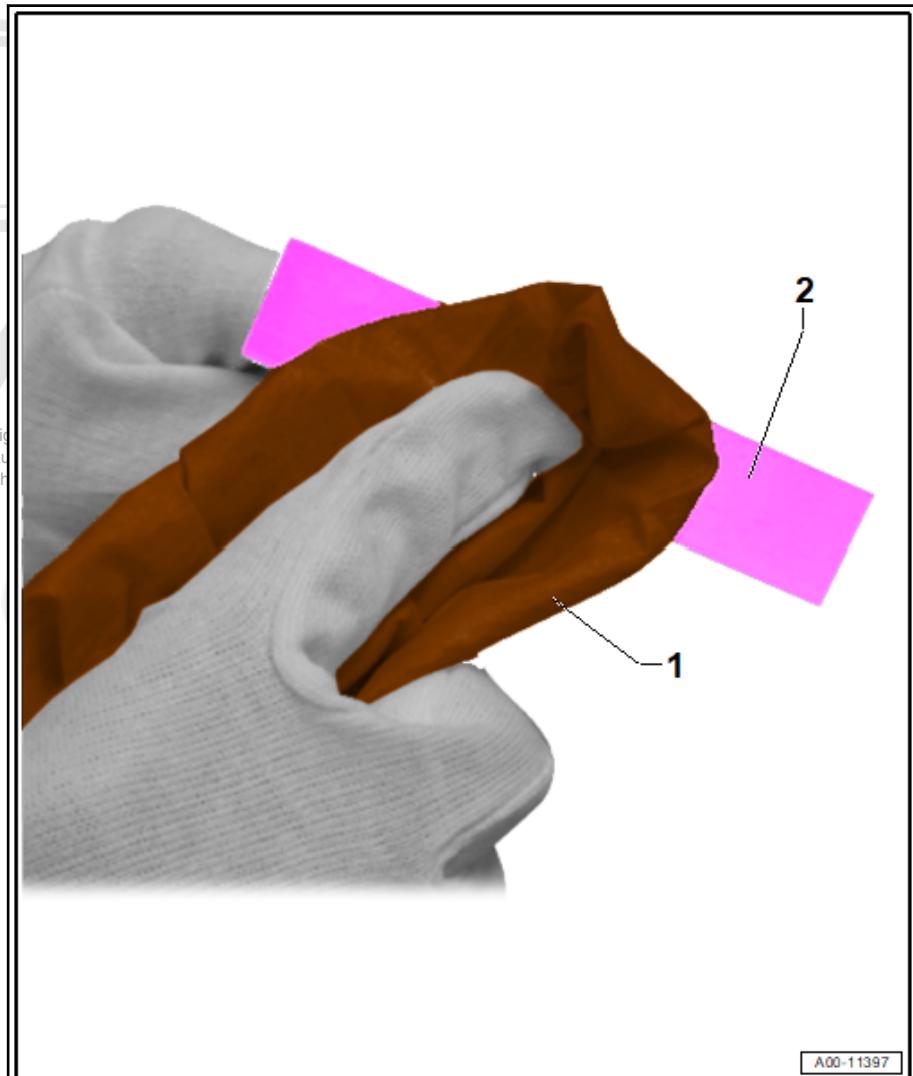


Note

After the last cleaning procedure the adhesive must be applied within four hours, to prevent contamination as well as the formation of an oxide coating on the aluminum material. Repeat the preparations after four hours if no adhesive was applied.

- Afterward clean the bare metal adhesive flange areas with a lint-free cloth, soaked with isopropyl alcohol or acetone, until no residue is visible on the cloth.
- Allow the cleaned surfaces to ventilate for 15 minutes, the adhesive surfaces must be completely dry.

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Processing conditions

The ambient and material temperature when processing, must be at least "minimum temperature 15 °C (59 °F)" and a most "maximum temperature 35 °C (95 °F)".

Higher processing temperatures reduce the processing time.

Processing time at 15 ° C 80 min

Processing time at 18 ° C 75 min

Processing time at 20 ° C 65 min

Processing time at 23 ° C 60 min

Processing time at 25 ° C 50 min

Processing time at 30 ° C 40 min

Processing time at 35 ° C 30 min

9.1.1 Joining Process



Note

- ◆ If the adhesive escapes on both sides along the entire length of the joining area, too much was applied.
- ◆ 1 cartridge with 195 ml is enough for approximately 5 meters of flange.

Adhesive cartridges must be used with plunger adhesive guns.

Tools

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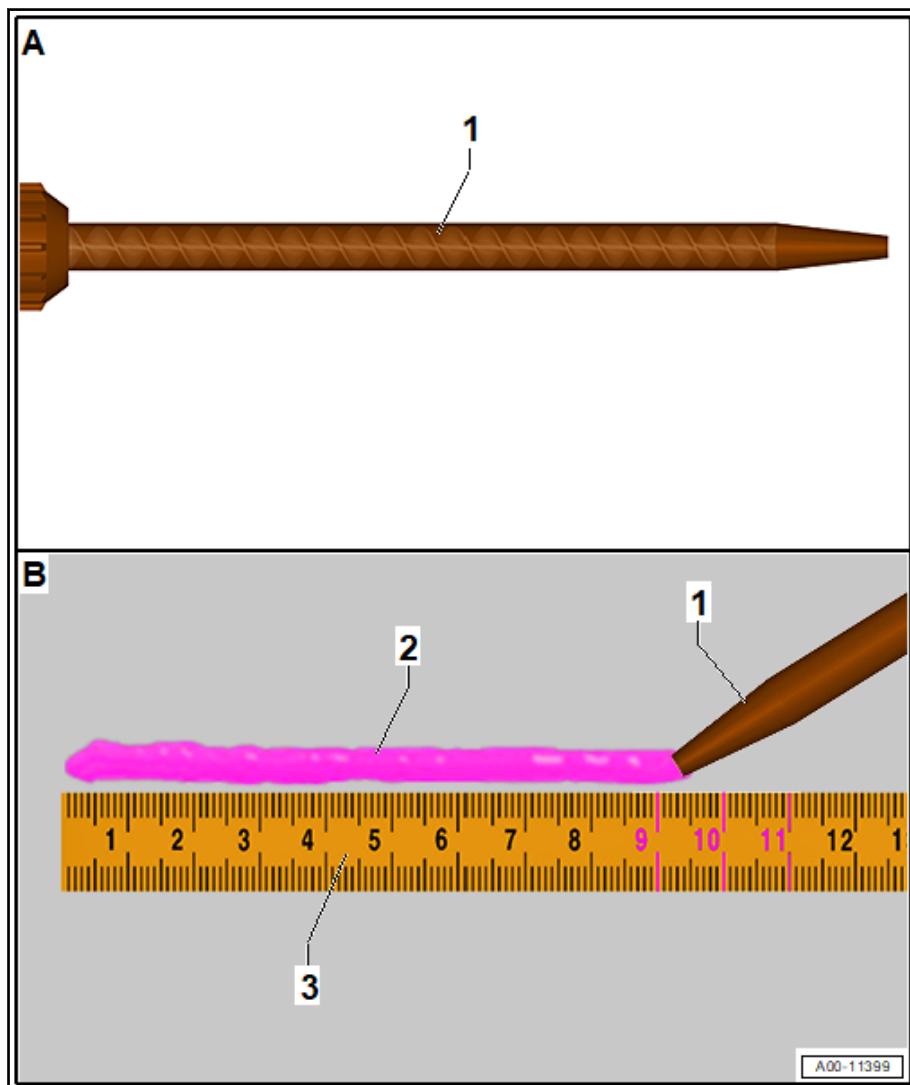
Prepare the Cartridge Gun V.A.G 1628 or V.A.G 1761/1 according to the instructions in this document. Copyright by AUDI AG.

Pneumatic Gun - 18 Bar - VAS 6648- or -

Pneumatic Cartridge Gun - V.A.G 1761/1- for seam sealing.

1 - Press out the adhesive without mixing tube, until both components exit the cartridge.

2 - Attach the mixing tube to the cartridge and check the exiting adhesive.



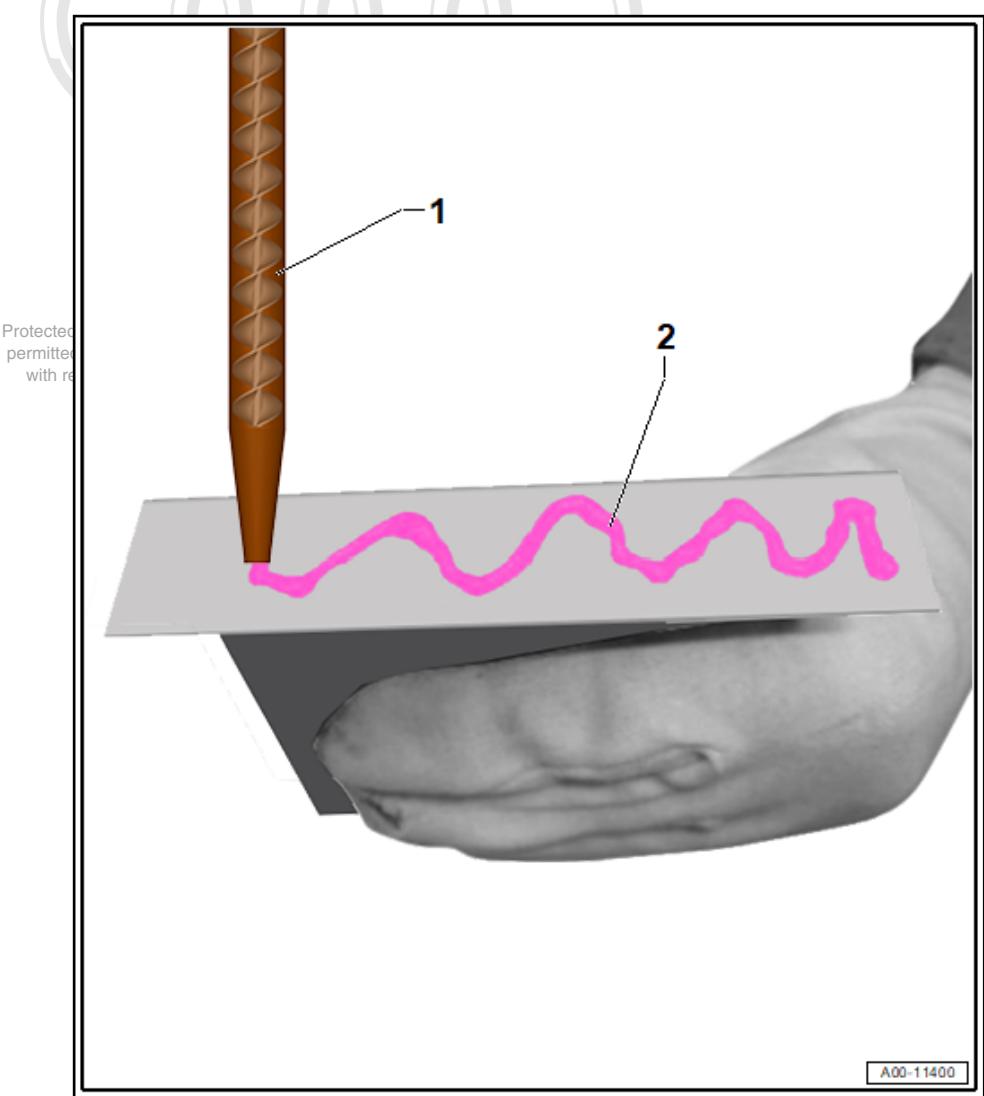
3 - Pay attention that both components evenly mix in the mixing tube.

4 - Before application to the joining area, apply a 10 to 20 cm bead on a paper towel or similar and throw away later on. The hardening process can also be checked with this bead.

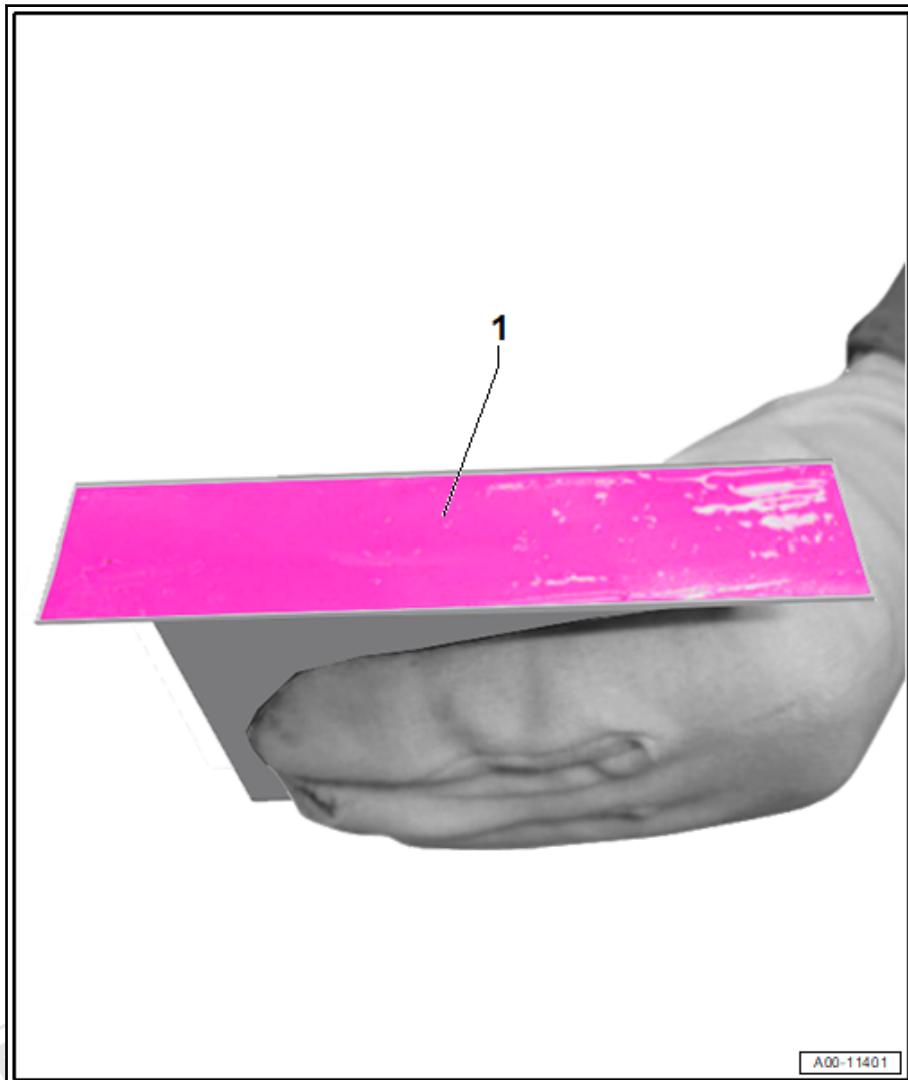
5 - In addition, apply an approximately 10 cm long sample adhesive bead on a paper towel or similar.

Apply the adhesive.

Applying adhesive on both joining area flanges.



Spreading the adhesive flat on both joining area flanges with clean tools. Application height 0.5 mm



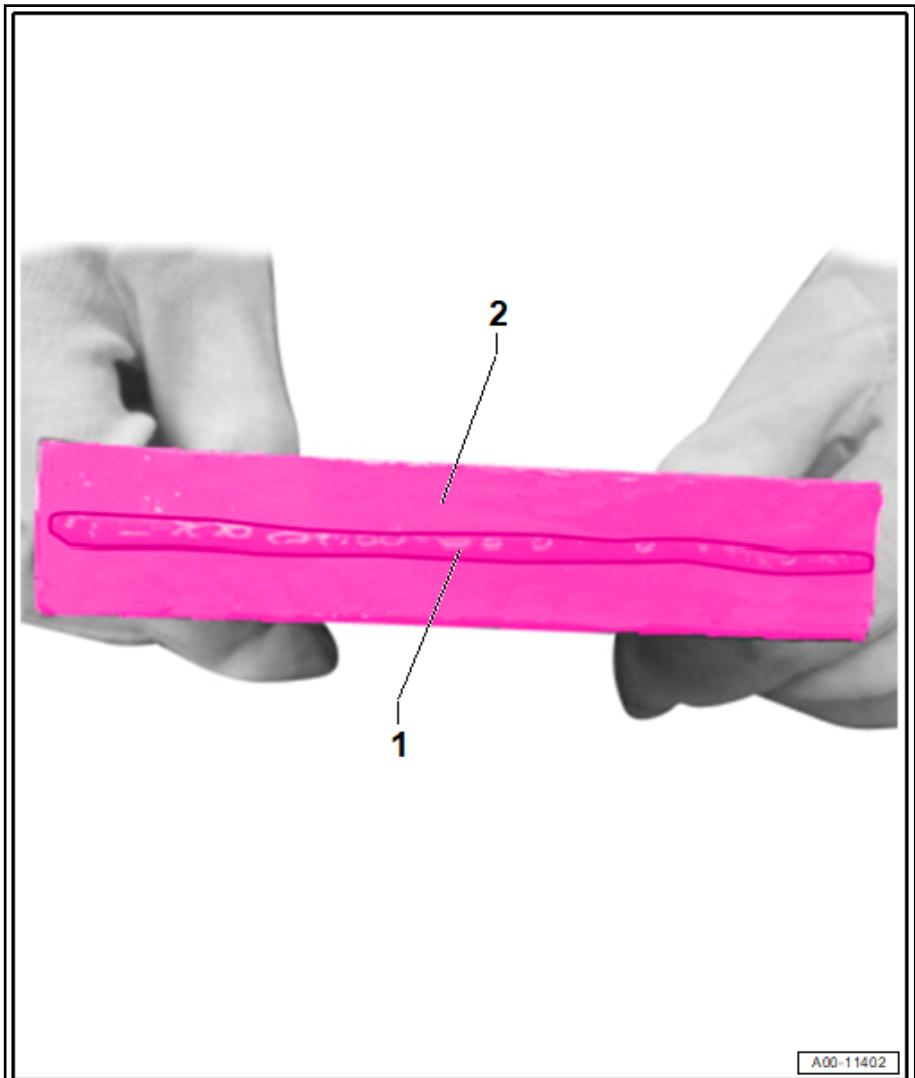
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- Locations uncoated with cataphoretic dip coating (CDC), or bare metal locations in cavities must be painted or filled with structural adhesive.
- Apply an additional adhesive bead to the center of the joining area.



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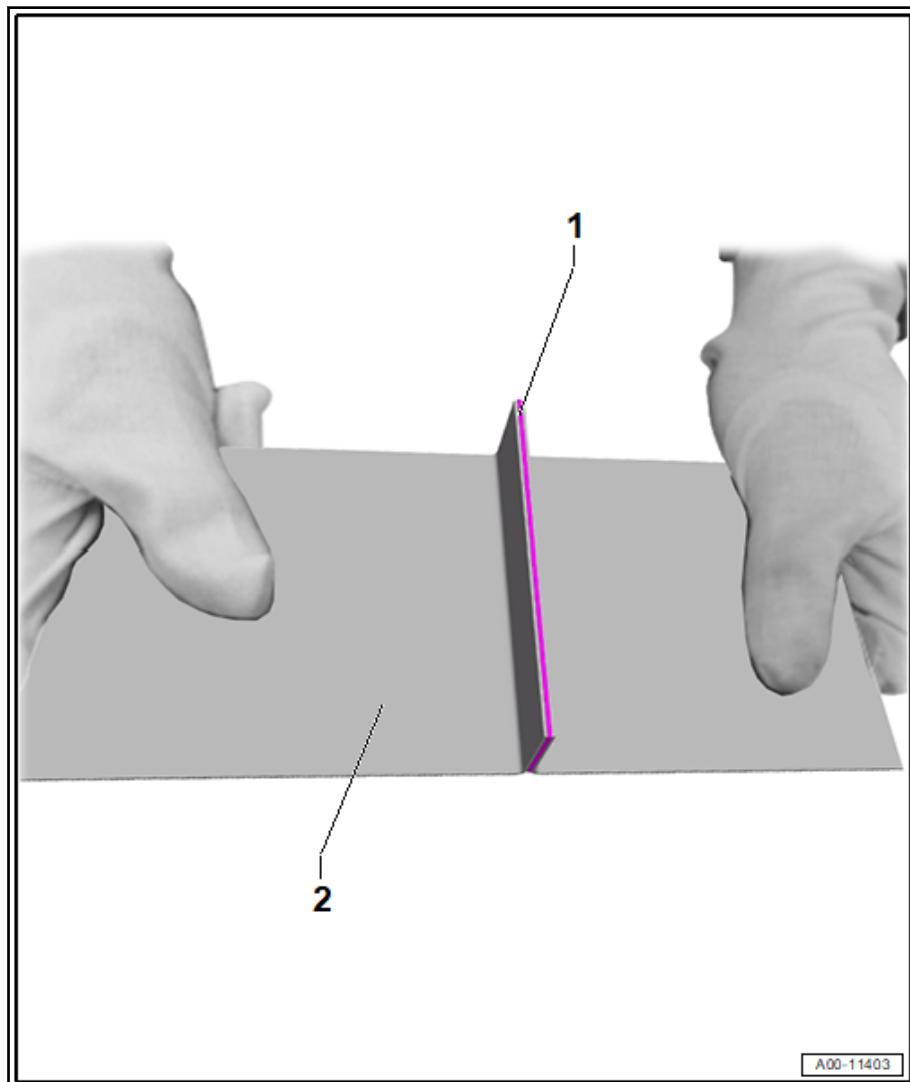


- Connect the parts.



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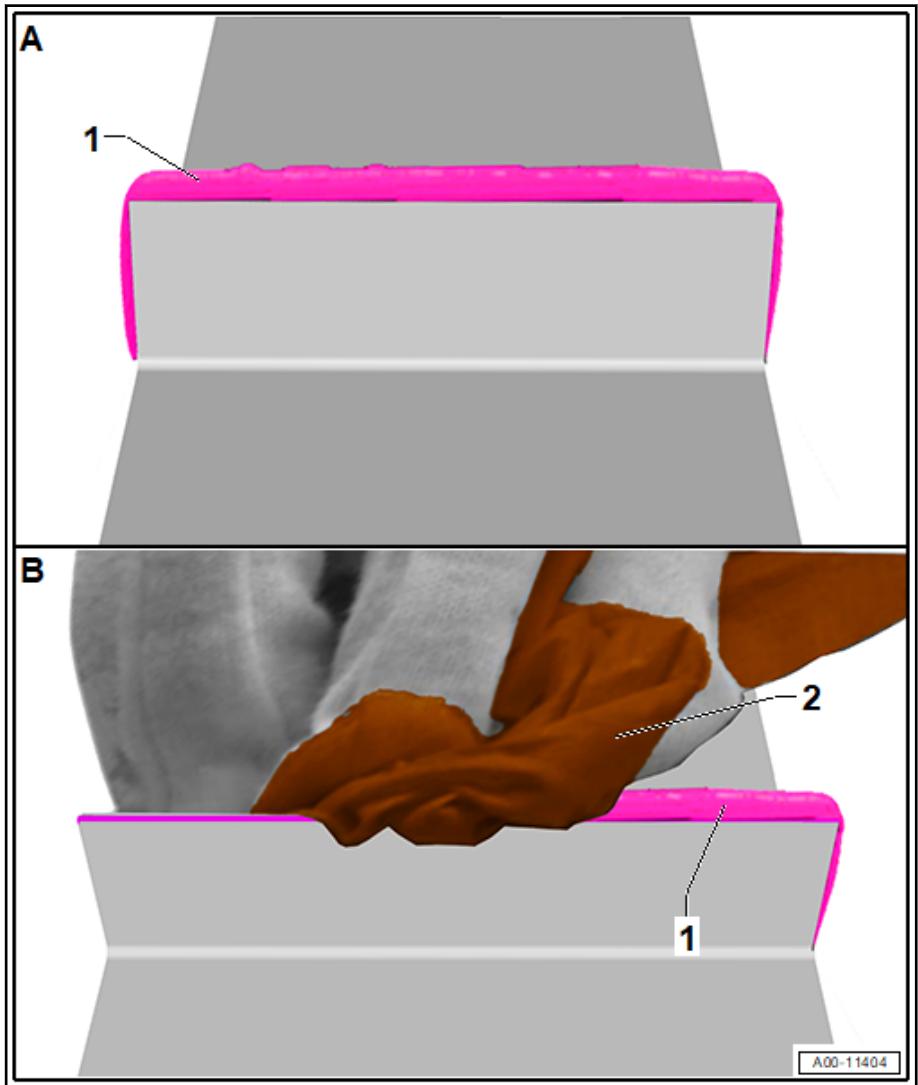
Connect the parts, secure them and adhere within the processing time.

Note

- ◆ *The connection must happen immediately after applying the adhesive, in order to ensure a high-quality and secure bonding.*
- ◆ *Otherwise the adhesive bead must be removed and the surface treatment and application of the adhesive must be repeated.*
- ◆ *The layer thickness of the adhesive after bonding must not exceed 1 mm.*
- Remove excess adhesive.

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Remove excess material with a clean towel.

Clean visible surfaces with a clean towel soaked in acetone.

Hardened material can only be removed mechanically.

9.1.2 Hardening

The body structural adhesive used hardens at temperatures between a minimum of 18 °C (64.4 °F) and a maximum of 80 °C (176 °F).

The hardening process can be sped up by heat (for example an infrared heater or in a paint booth).

Infrared heaters only heat up sections of the body and are thus only suitable for small repairs.

Only use devices with a temperature setting, automatic distance measuring and visualization of the measuring point.

Do not stress bonded parts until assembling stability is reached.

9.1.3 Assembling Stability



Note

- ◆ *The temperature of the object must be above the minimum temperature for hardening for the entire time.*
- ◆ *If the minimum temperature for hardening has not been kept for the specified time, the waiting period must be prolonged or additional heat must be applied to the adhesive bond.*
- ◆ *If the minimum temperature for hardening falls below significantly, this can lead to irreversible damages in the bonded joint. This has a negative effect on the strength of the bonded joint.*



Note

After the assembly stability has been reached the vehicle can be lifted off the alignment system. Assembly work can be performed.

- Moving and further processing at the vehicle after repair bonding is only allowed after a minimum curing time of 12 h at 23 °C (73.4 °F).

The waiting period can be reduced by applying heat. For example, curing time at 60 °C (140 °F) 60 min.



Note

- ◆ *The temperature of the object must be above the minimum temperature for hardening for the entire time.*
- ◆ *If the minimum temperature for hardening has not been kept for the specified time, the waiting period must be prolonged or additional heat must be applied to the adhesive bond.*
- ◆ *If the minimum temperature for hardening falls below significantly, this can lead to irreversible damages in the bonded joint. This has a negative effect on the strength of the bonded joint.*

After this time the vehicle meets the crash requirements and may be moved under traffic laws.

The vehicle can be handed over to the customer.

The time frame from connecting the repaired parts until operation must be a minimum of 96 h at 18 °C (64.4 °F).

9.1.4 Corrosion Protection

Carefully prime the accessible adhesion areas after hardening and seal them with body sealant.

Protect adhesion areas in cavities against corrosion using cavity sealant.

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9.1.5 Work Sample



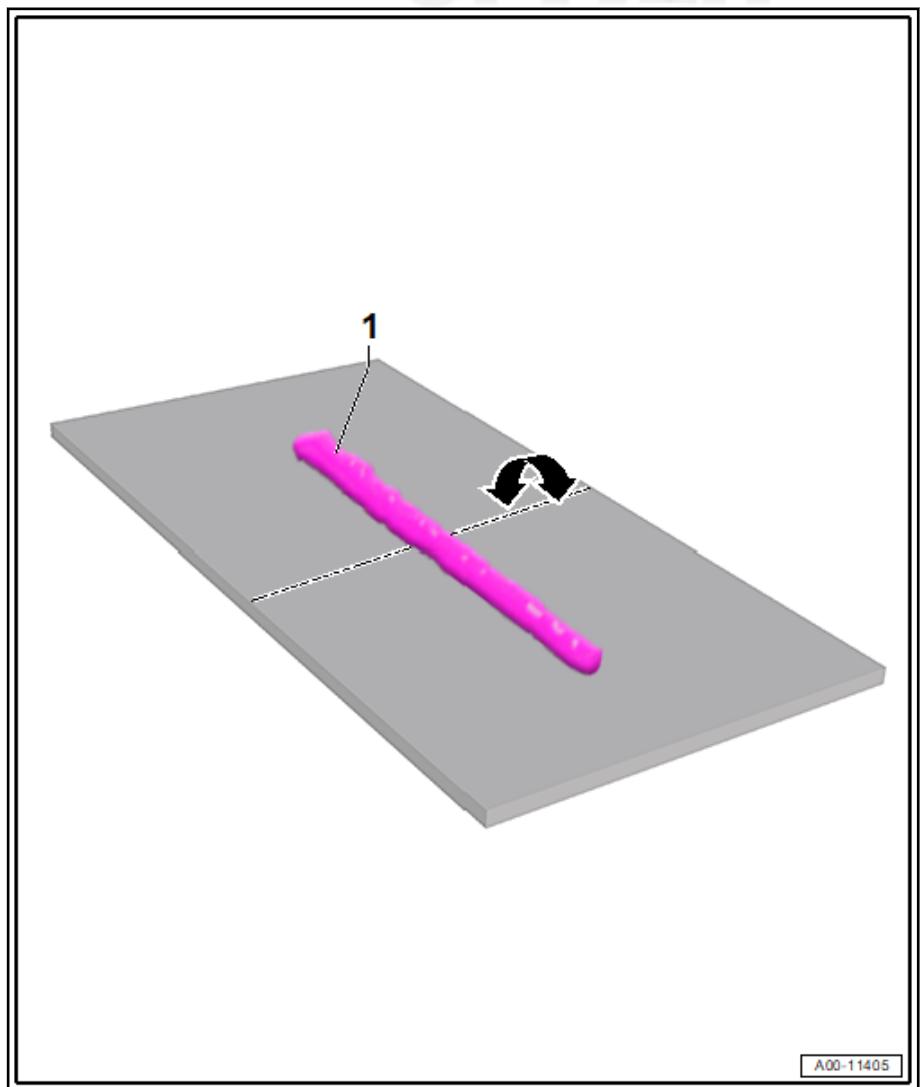
Note

A work sample can be created to make sure there is a correct bond. The creation of the work sample is described in the processing instructions of the adhesive.

- With a negative result of the working sample (no correct hardening), no correct bonding can be ensured.
- In this case measures must be taken to ensure correct hardening or repeat the adhesion if necessary.

Check and evaluate the hardening of the work sample -1- after reaching assembling stability by breaking the sample -arrow-. The adhesive must break and contain no liquid or soft components.

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10 Friction Element Welded Connection, Replacing

⇒ “10.1 Friction Element Welding Connections (Countersunk Head Friction Element), Loosening”, page 55

Friction element welded connections are used with multi material shells to connect high strength steels with aluminum parts. A distinction is made between standard friction elements and countersunk head friction elements. The present document describes the different possibilities to replace all friction element welded connections. The procedure to be used is specified in the shell construction repair manuals at the areas of application.



Note

The following description is to be used as guidance only. The description of the work procedure as well as the different areas of application can be found in the operating instructions of the respective device.



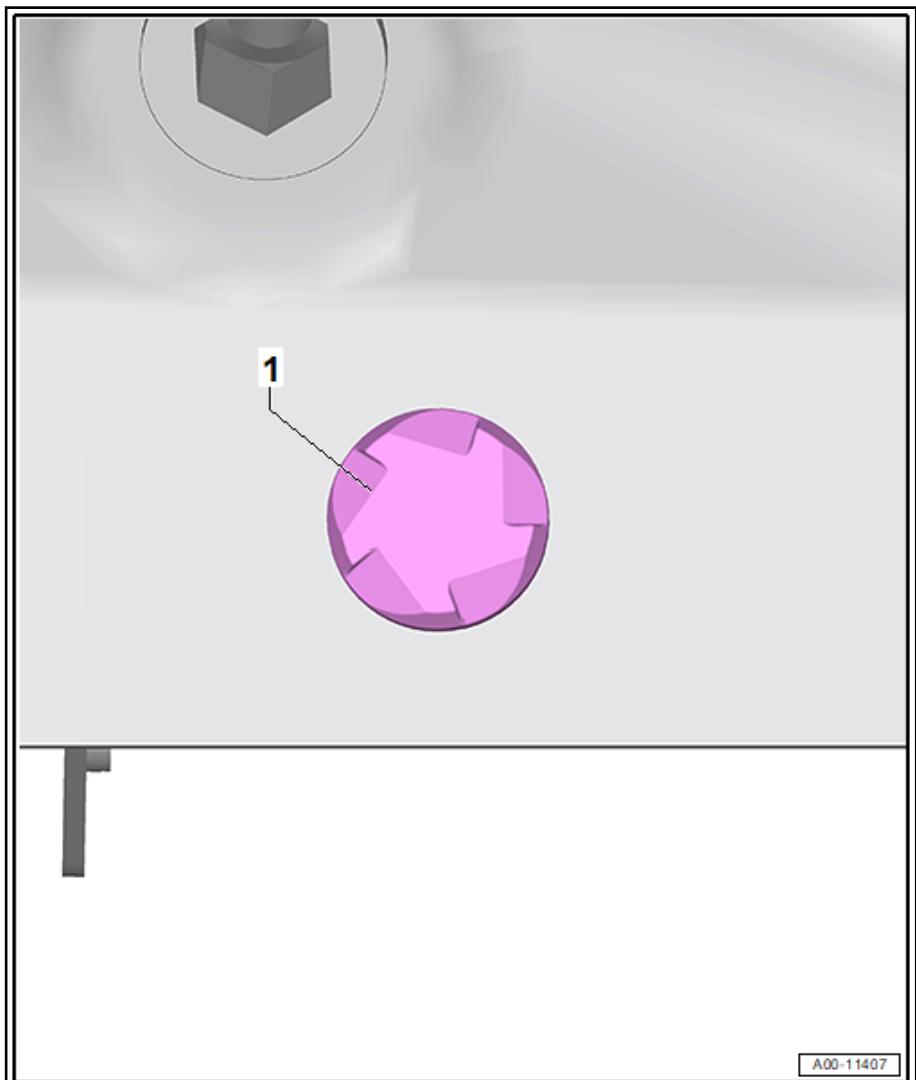
Note

The fixture to be used and the matching gas tube differ depending on the type of stud to be welded. The correct pairing can be found in the operating instructions which came with the device.



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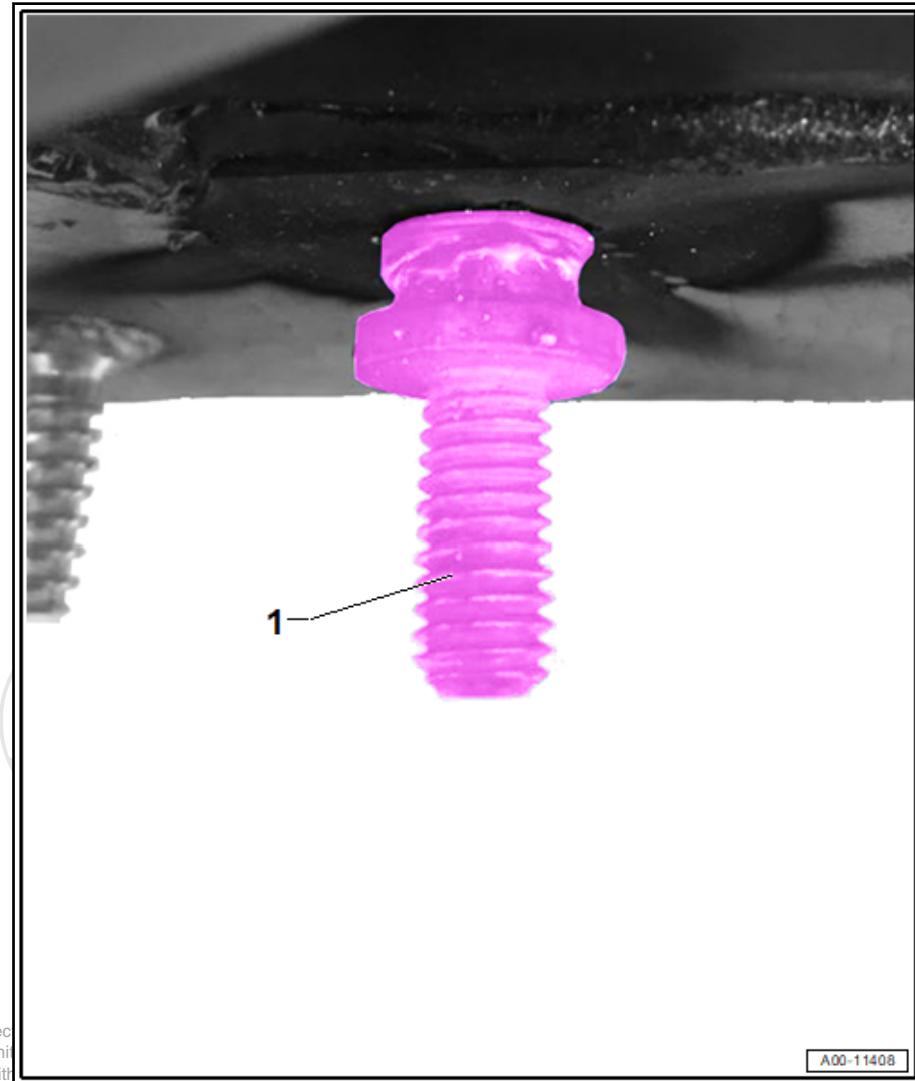


- Remove the paint and oxide coating from the rivet head and the connection point for the ground clamps.
- Attach the ground clamps as close as possible to the rivets.

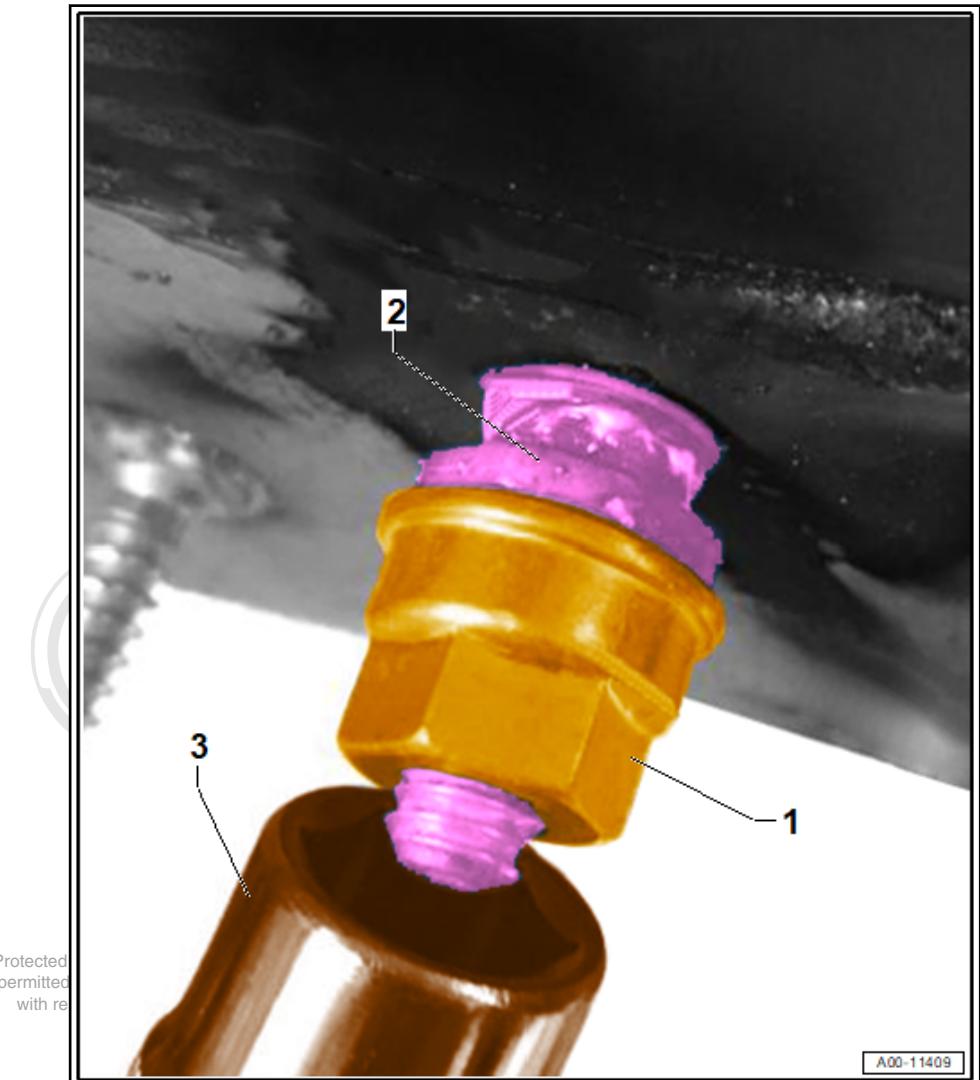
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Pin	Weld ing time (ms)	Am- per- age (A)	Lift (mm)	Pre- gas time (ms)	Gas par- ame- ters	Posi- tive me- ter- minal	Grou- nd ter- minal	Po- lar- ity
M6 stain- less steel pins	32	650	1.0	1000	10	Com- po- nen- tary	Weld- ing gun	Re- ver- sed po- lar- ity

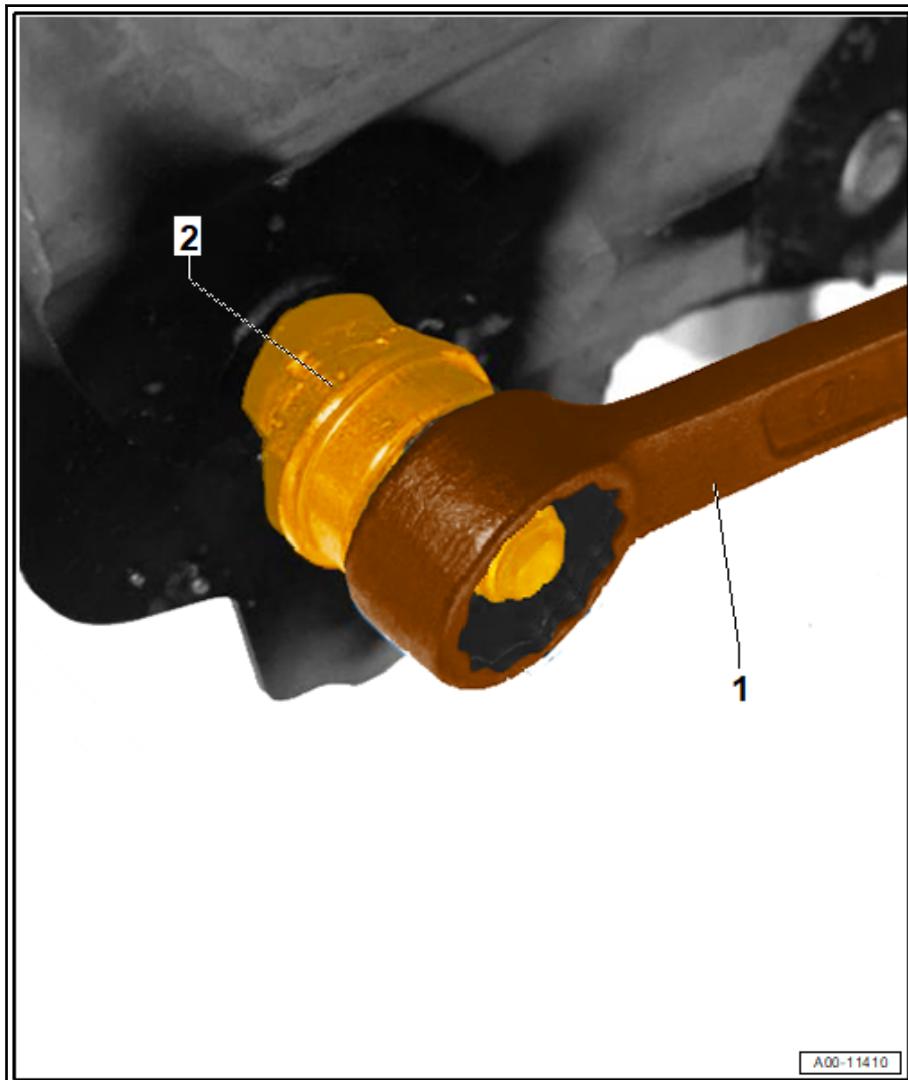
- Weld on the Weld Screw -1- onto the friction element using the AluRepair VISAR Stud Welder (USA Only) - VAS 852 001- approved by the AUDI AG.



- Install the welding stud hex nut -1- onto the stud -2-.



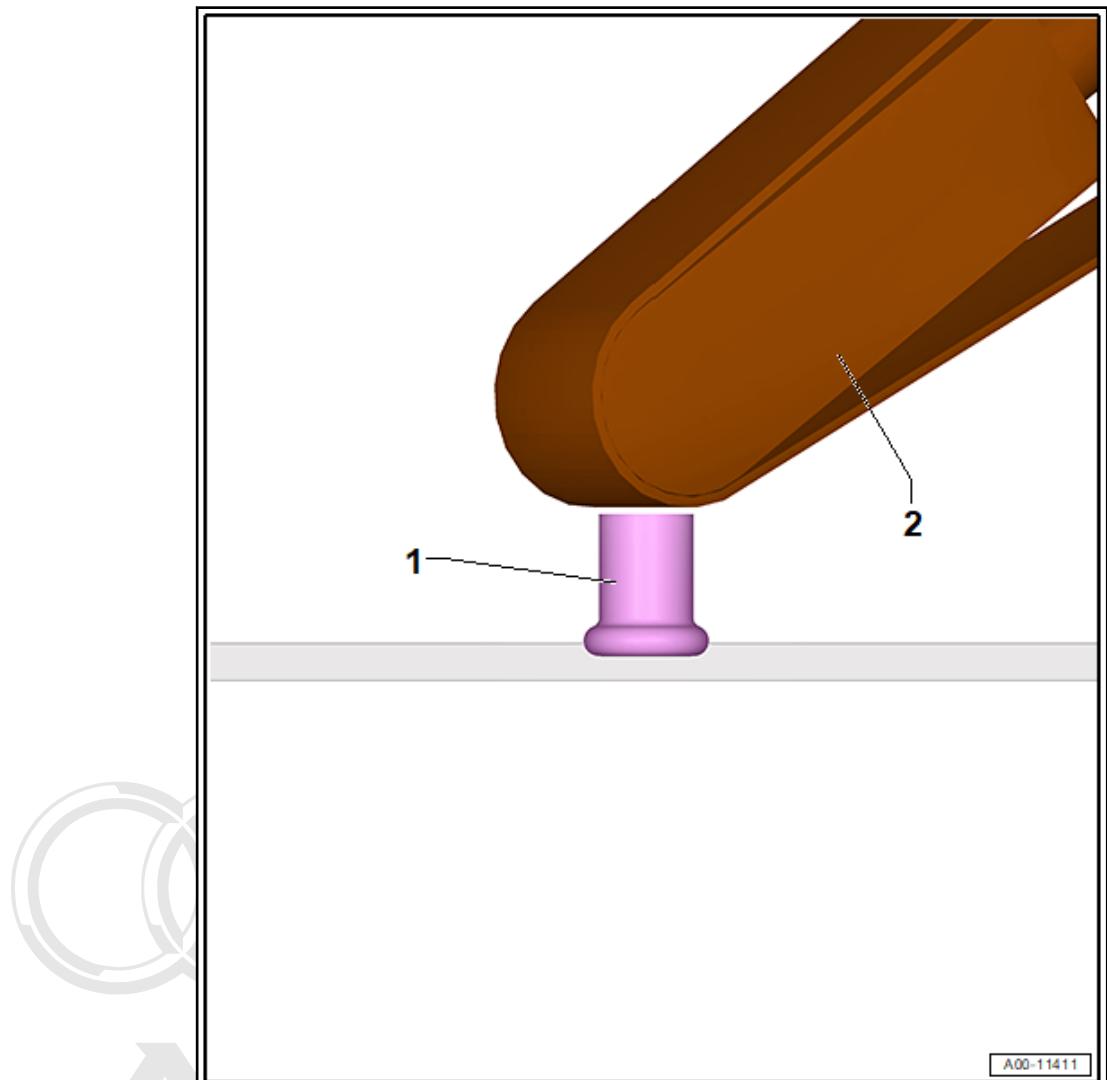
- Disconnect the element head by overtightening the welding stud.



- Sand off the remaining element base -1- of the friction element.



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10.1 Friction Element Welding Connections (Countersunk Head Friction Element), Loosening

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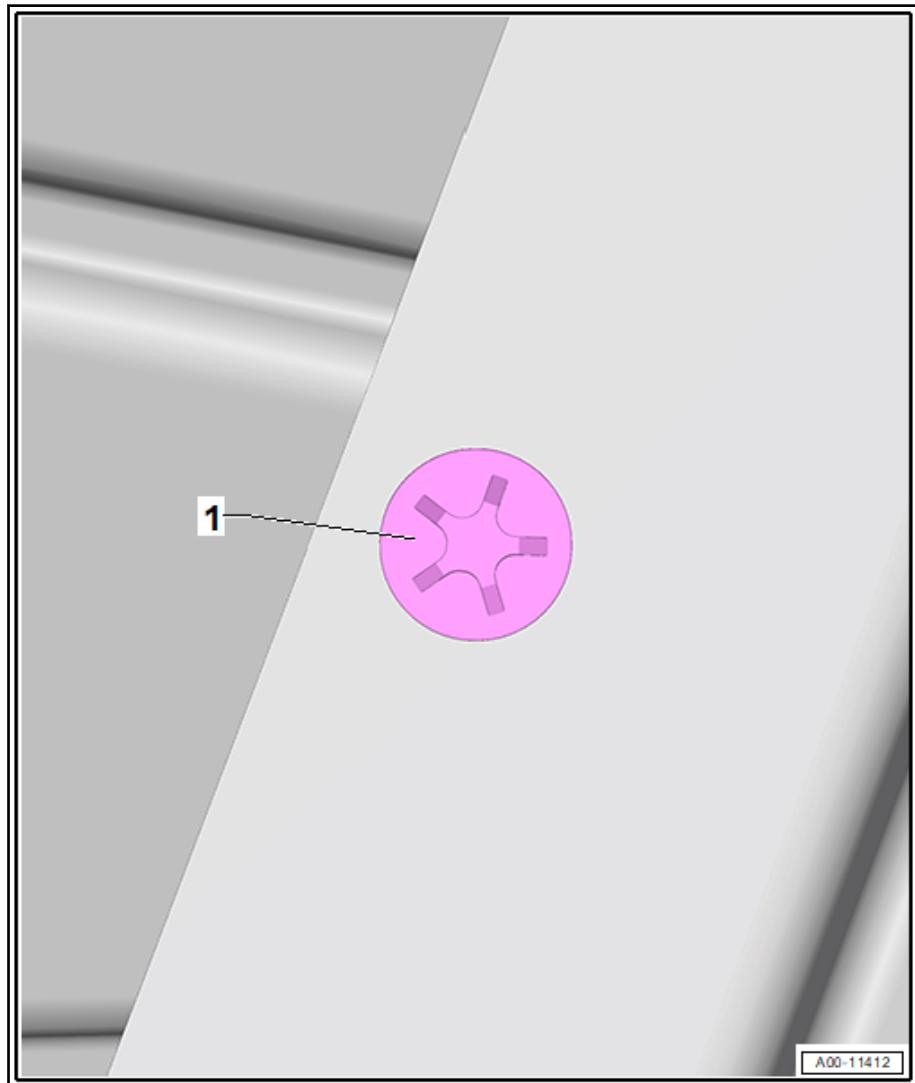
⇒ [“10.1.1 Flow Form Weld Rivets, Placing”, page 58](#)



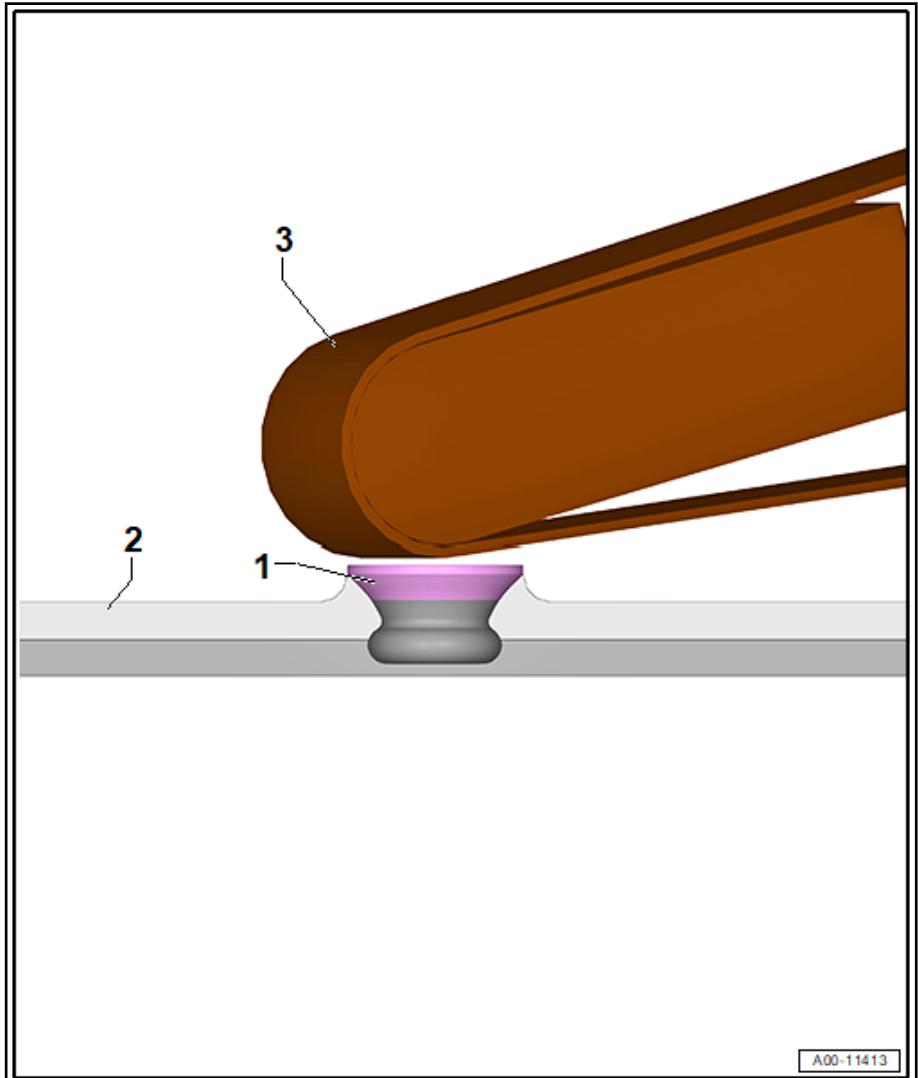
Note

The following description is to be used as guidance only. The description of the work procedure as well as the different areas of application can be found in the operating instructions of the respective device.

Countersunk head friction element -1-

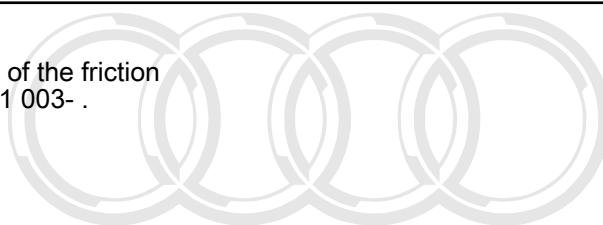


- Grind down the upper friction element -1- using the -3- Belt Sander - VAS 881 003- , until the cover plate -2- can be lifted off.



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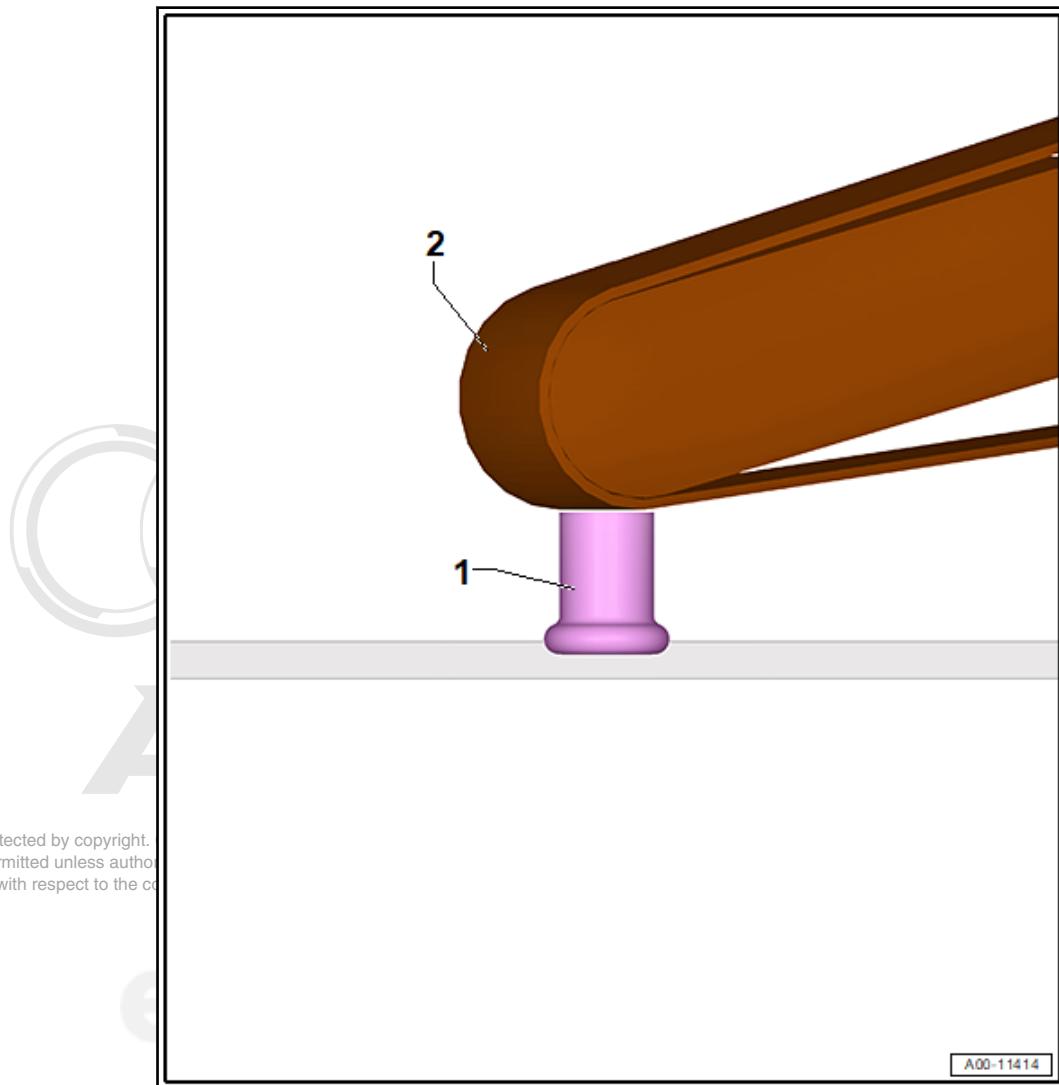
- Grind down the remaining element base -1- of the friction element using the -2- Belt Sander - VAS 881 003- .



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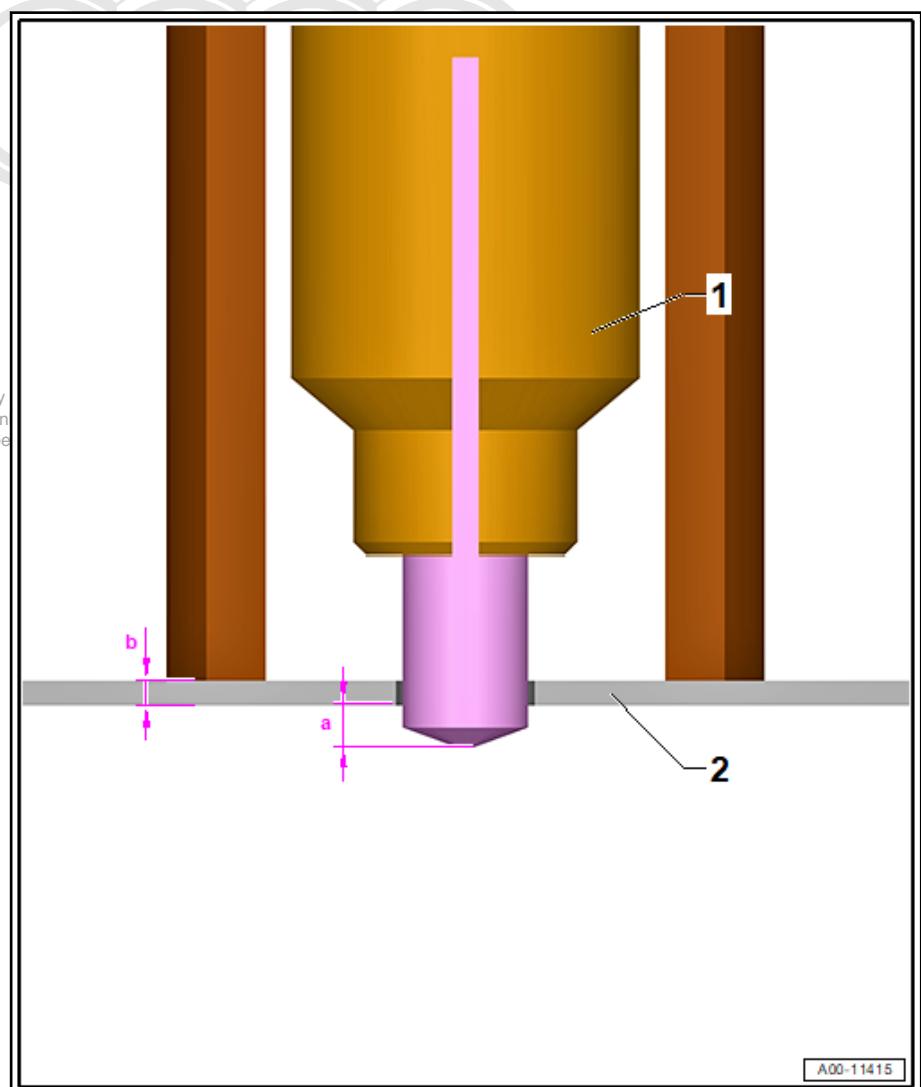
10.1.1 Flow Form Weld Rivets, Placing

Adapt the projecting end of the stud holder -1- with a flow form weld rivet to the material strength of the aluminum component:

-a: standard projecting end

Dimension -a- = 2 mm.

-b: additional projecting end due to the material strength of the aluminum replacement part -2-



Note

- ◆ Pay attention to the following before welding:
- ◆ The coating on the flow form weld rivet must not be damaged.
- ◆ The flow form weld rivet must not touch the aluminum replacement part, otherwise there may be a short when welding.

Reference welding values for flow form weld rivet

Pin	Weld ing time (ms)	Am- per- age (A)	Lift (mm)	Pre- gas time (ms)	Gas pa- ra- me- ters	Posi- tive ra- meters (l/ min)	Grou- nd ter- minal	Po- lar- ity minal
Flow form weld riv- et	7	910	1.0	1500	6	Weld throu- gh 8	Com- po- gun	Nor- mal ment



Adjust the pressure setting at the Compact Booster VAS6790 to pressure stage 4.



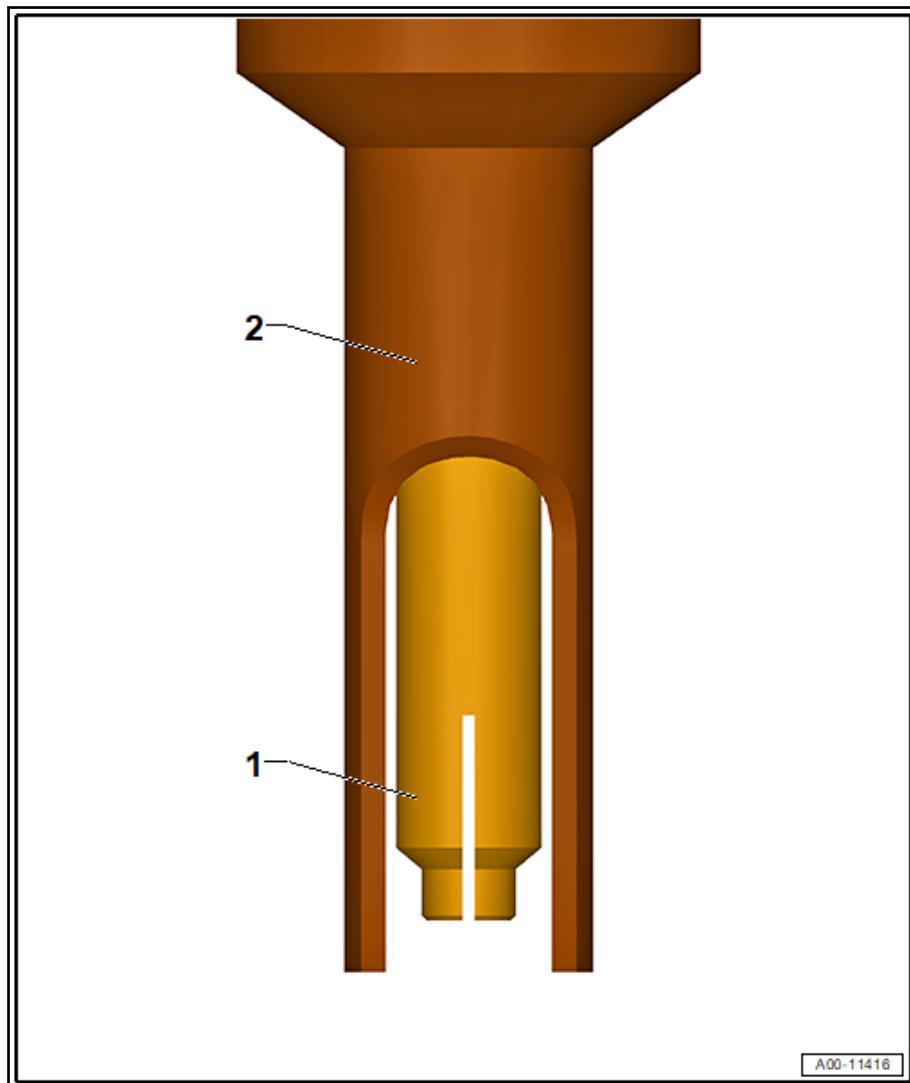
The loosened friction element weld seams are replaced by flow form weld riveting if not otherwise specified in the repair manual. Additionally, the components are bonded at the joining location.

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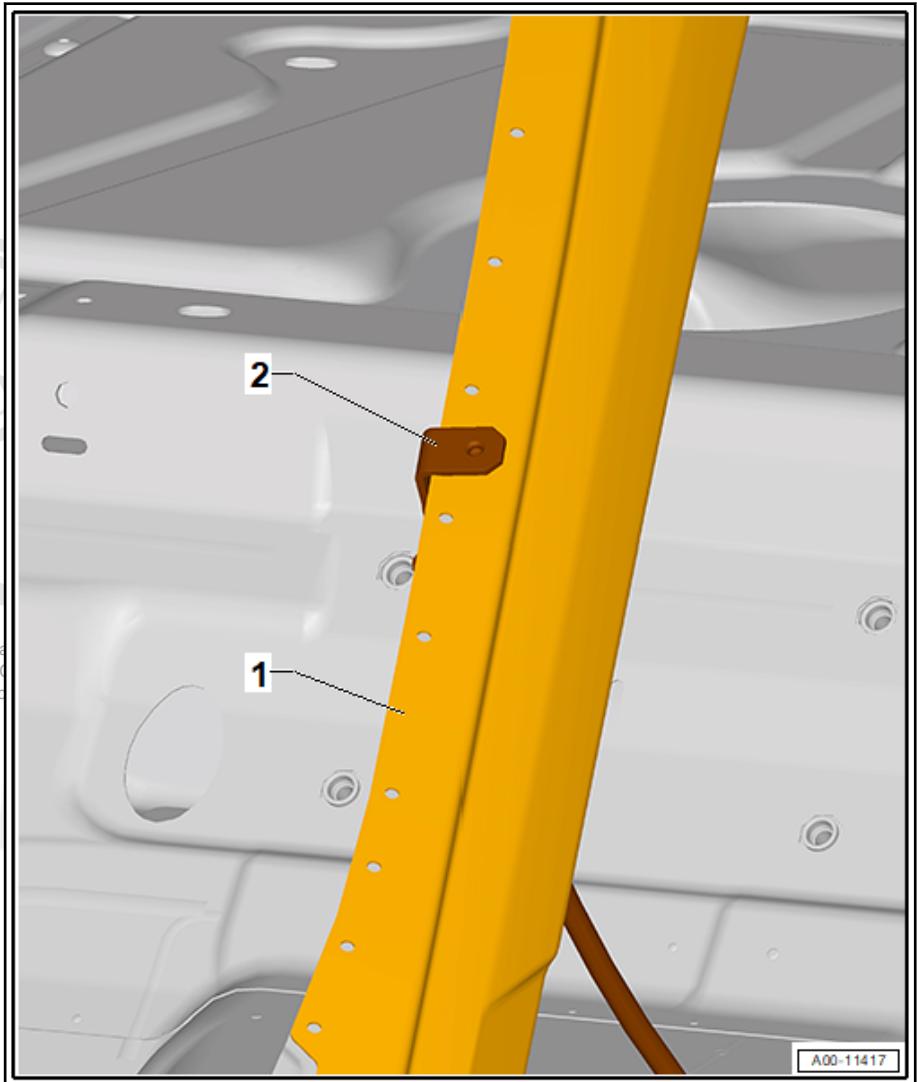
Drill a hole into the aluminum replacement part at the location specified in the repair manual with a 7 mm drill bit.

Prepare the stud welding unit and the components for welding.

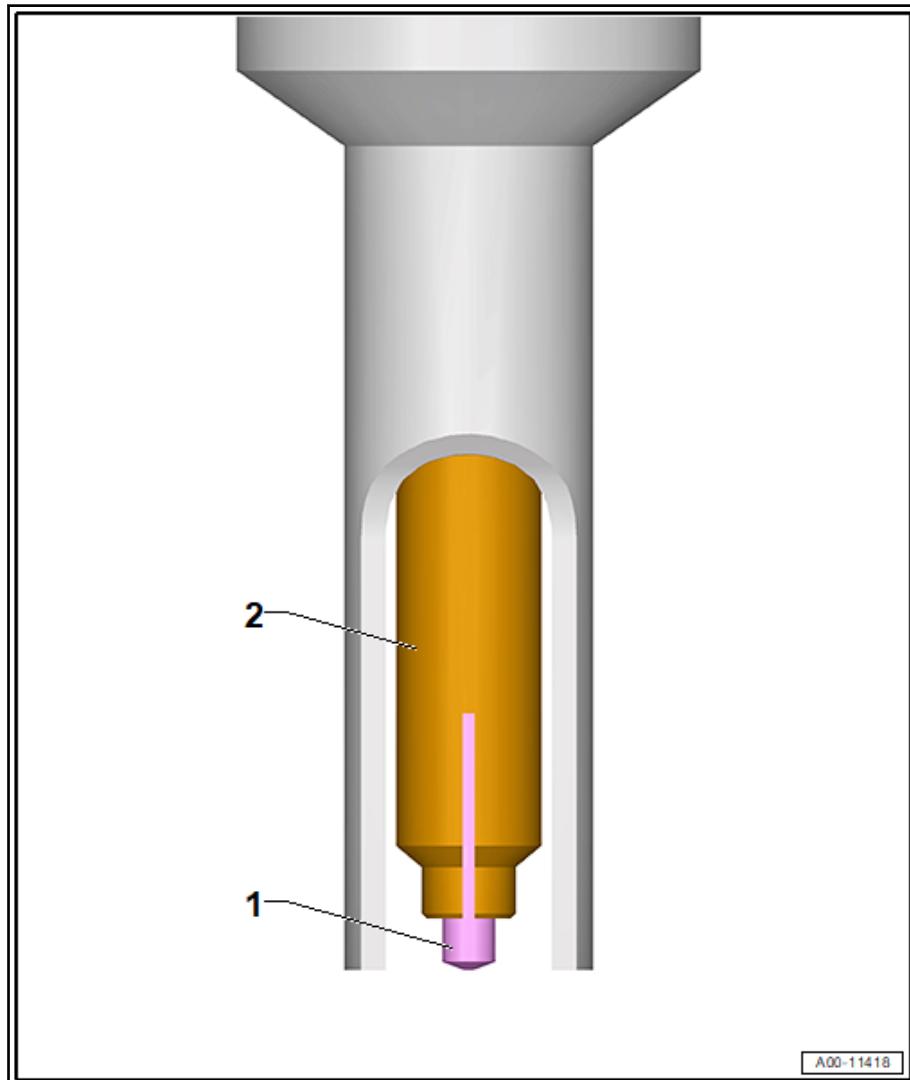
- Install the stud holder -1- River Holder - VAS 852 001/5- for the flow form weld riveting.
- Attach the open gas nozzle -2-.



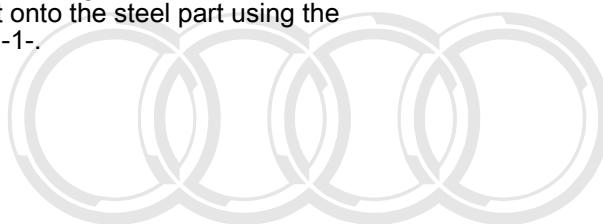
- Position and secure the aluminum replacement part -1- on the steel part using Locking Pliers -2-.



- Attach the flow form weld rivet -1- onto the stud holder -2-
River Holder - VAS 852 001/5- .

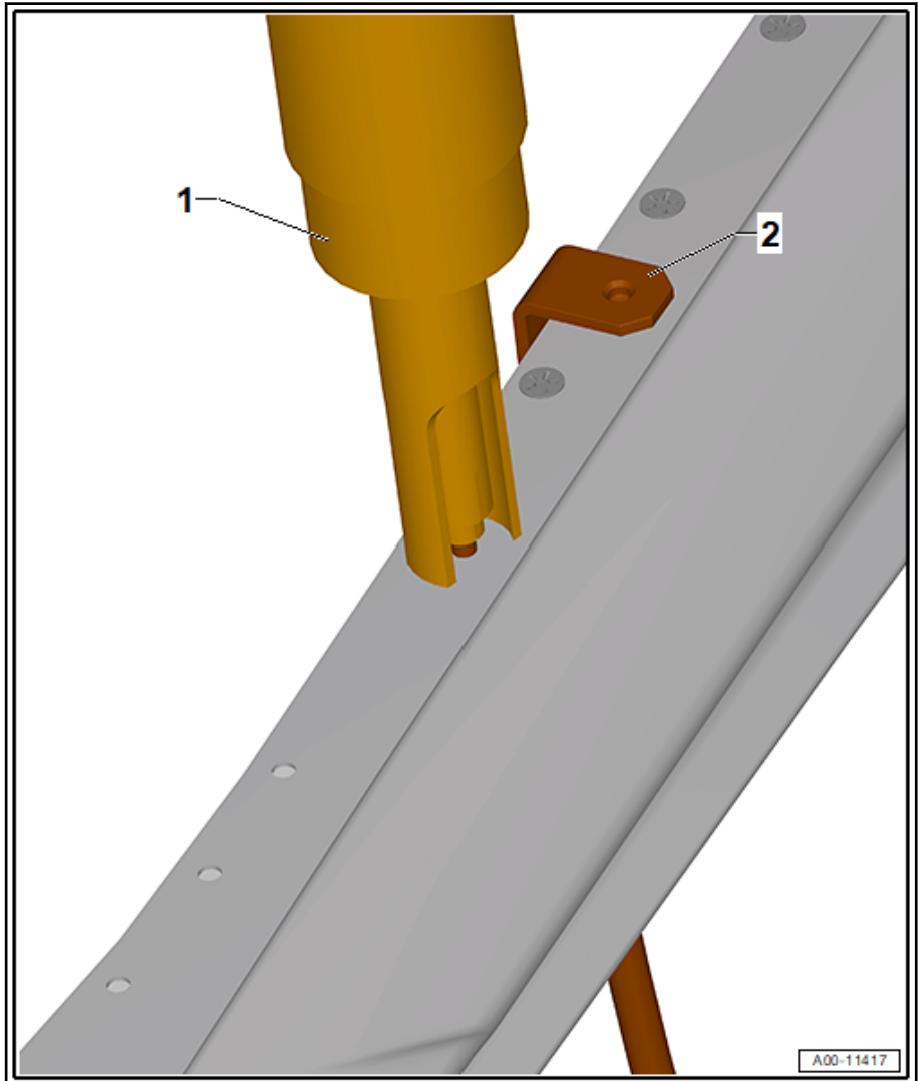


- Weld on the flow form weld rivet through the drilled hole in the aluminum replacement part onto the steel part using the Rivet Holder - VAS 852 001/5- -1-.



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A00-11417

Prepare the steel and aluminum parts for bonding and riveting and coat with adhesive. Refer to ["9 Body Structural Adhesive D 180 004 M2, Application", page 37](#).

- Place and press the flow form weld rivets -3- using the Pneumatic-Hydraulic Riveter Set - VAS 6790- -1- and the punches and dies -2- from the Riveting Die Kit - VAS 6790/70- .

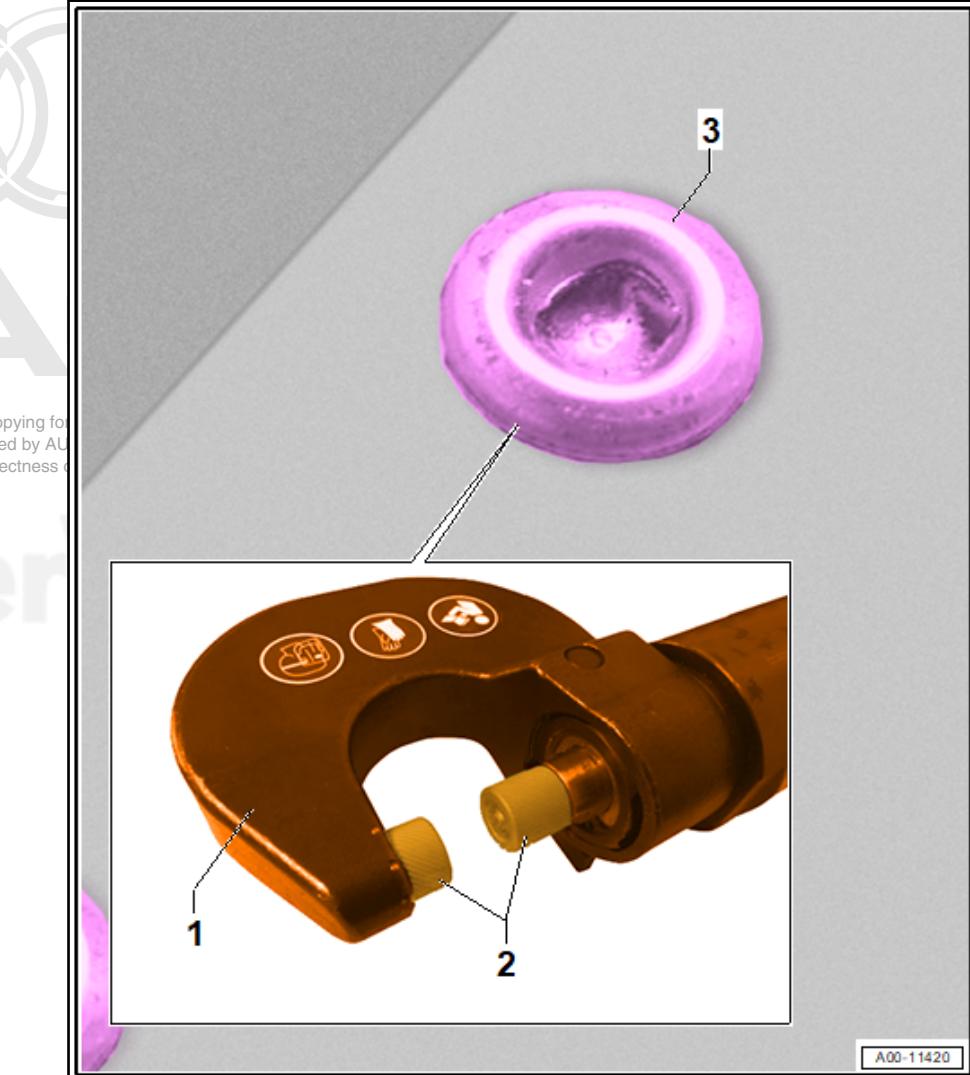
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11 Cold Joining Procedures

- ⇒ “11.1 Rivets”, page 65
- ⇒ “11.2 Flow-Drill Bolts”, page 70
- ⇒ “11.3 Clinching”, page 72

11.1 Rivets

- ⇒ “11.1.1 Solid Rivet”, page 65
- ⇒ “11.1.2 Pop Rivet”, page 66
- ⇒ “11.1.3 Rivet Problems”, page 67
- ⇒ “11.1.4 Kerb-Konus Rivets”, page 69



Note

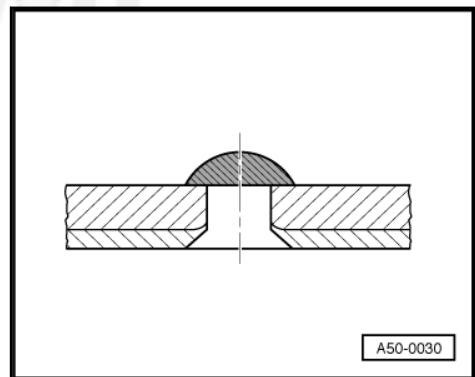
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Please refer to the vehicle-specific repair manuals or the Workshop Equipment Catalog for information on required special tools, testing equipment, and tools.

11.1.1 Solid Rivet

Opening the solid rivet

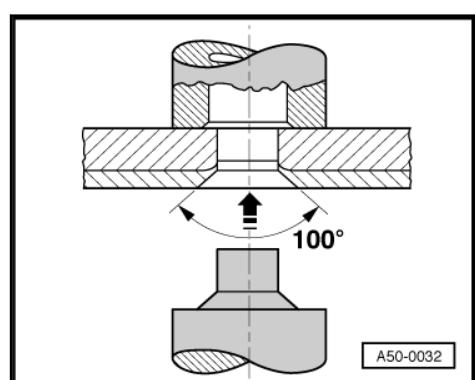
- First make separating cuts, if necessary.
- Sand off closing head and press out the solid rivet with the rivet tool.
- Remove the damaged part, separate with a chisel if necessary.



Solid Rivet, Installing

- Fit new parts, apply adhesive and place new part on body and secure.
- Stamp the flange with the rivet tool.

When stamping, the punch hole and the imprint are made in one process.



Note

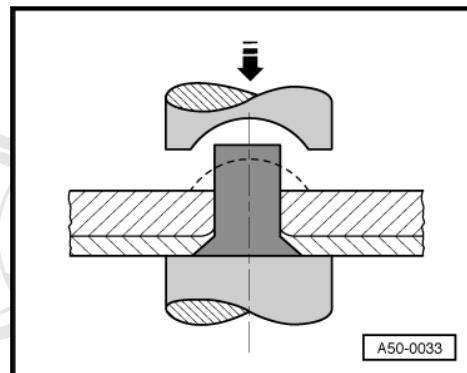
Adjust the rivet tool to material thickness for all procedures. To prevent flange from gaping after stamping, insert staples in the punched holes.

- Insert the solid rivet and affix the closing head using the rivet tool.

There are corresponding rivet tool inserts for the various rivet diameters.

Note

- ◆ Contrary to the series, all rivet connections are also bonded in service. Refer to bonded joint. The solid rivet is made out of aluminum.
- ◆ There are different solid rivets available. Refer to the vehicle-specific instructions for this.



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11.1.2 Pop Rivet

Opening the pop rivet

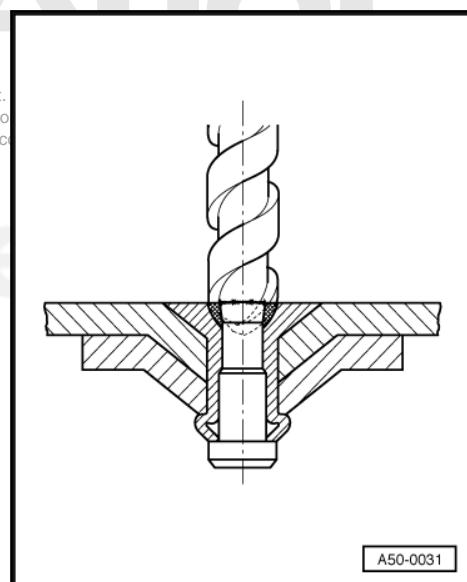
- First make separating cuts, if necessary.
- Drill out the pop rivet, drill bit diameter 4.5 mm.
- Remove the damaged part, separate with a chisel if necessary.

Note

Catch pop rivet remnants. If remnants fall into the cavities and can no longer be removed, they must be worked into the filler wax.

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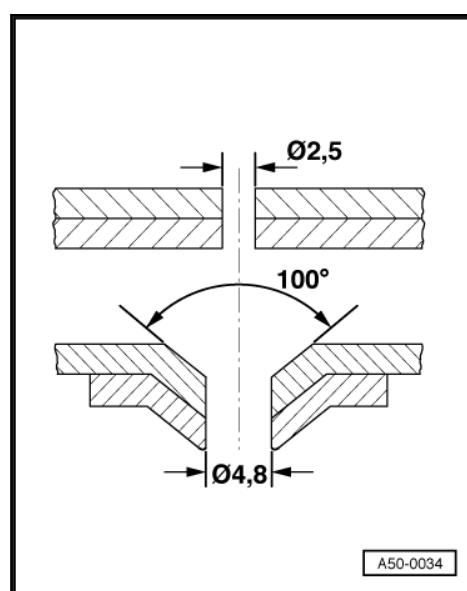
A50-0031

Pop Rivet, Installing

- Fit new parts, place on body and secure.
- Drill old and new part or same material together, 2.5 mm diameter.
- Remove the new parts.
- Imprint drilled holes in all parts with rivet tool.

Note

- ◆ Adjust the rivet tool to material thickness for all procedures. The diameter increases to 4.8 mm with imprinting. The imprint must face inward on all parts.
- ◆ Assembly sections cannot be imprinted. Lower the new part with assembly section, remove part and drill out the assembly section to 4.8 mm diameter.
- Apply the adhesive.



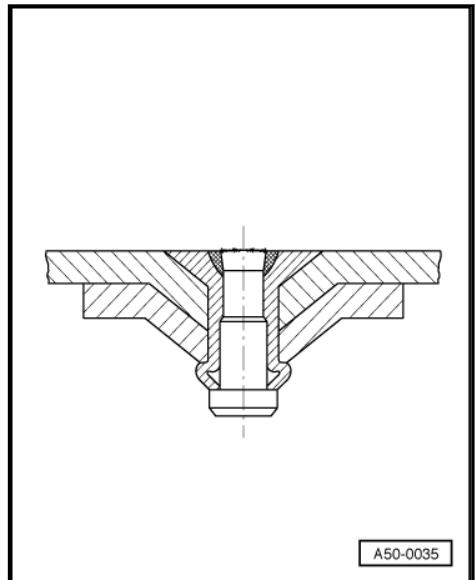
A50-0034

- Insert the pop rivet and pull the pin with rivet pliers.



Note

- ◆ Contrary to the series, all rivet connections are also bonded in service. Refer to ["9 Body Structural Adhesive D 180 004 M2, Application", page 37](#).
- ◆ There are different pop rivets available. Refer to the vehicle-specific instructions for this.



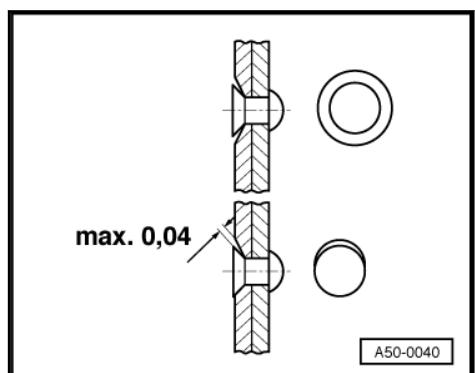
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11.1.3 Rivet Problems

Open countersinks

Open countersinks over the entire circumference are not permitted. Partially open countersinks up to a gap width of 0.04 mm are permitted.

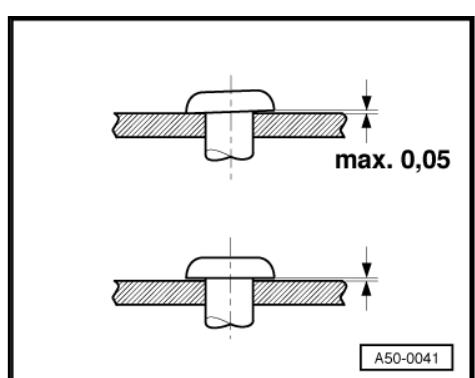
Sizing, for example, with a cambered die, is permitted as long as the tolerance for closing and setting head are maintained.



Non-fitting rivet heads

Loose rivets are never permitted.

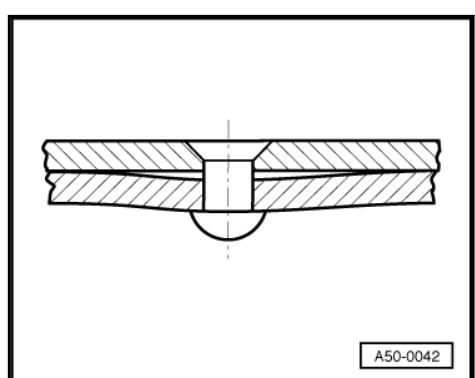
A partial gap up to 0.05 mm is permitted.



Bulges at the rivet connection

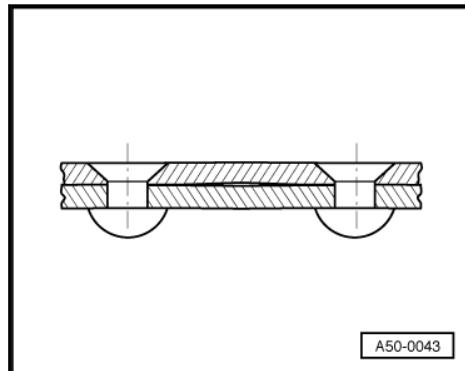
During the riveting process, the rivet material is pushed into the gap and causes bending stress to the rivet.

This type of bulge is not permitted.



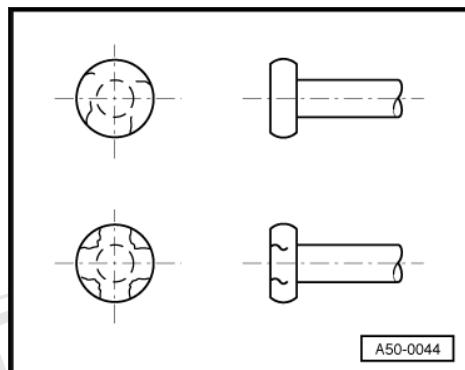
Bulges between the rivet connections

Bulges may not exceed a gap width of 0.3 mm.



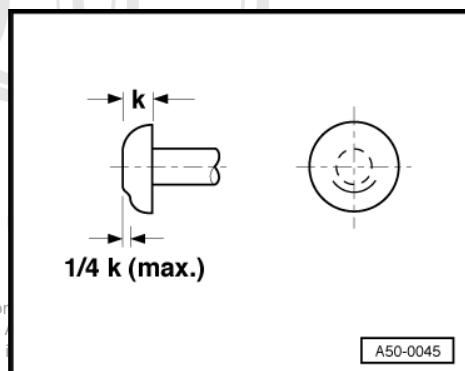
Shear cracks

Cracks that do not overlap are permitted (top).



Notches

The permitted notch depth is $1/4 * \text{height of the head}$.

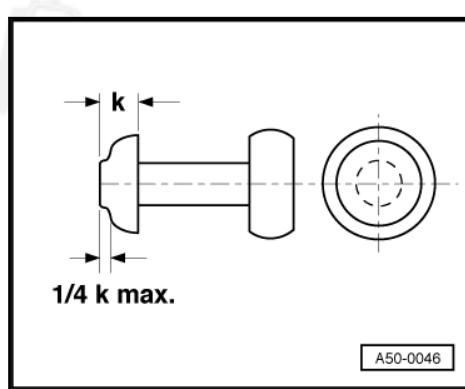


Rings

Rings form in the head when a riveting header is used that is too small.

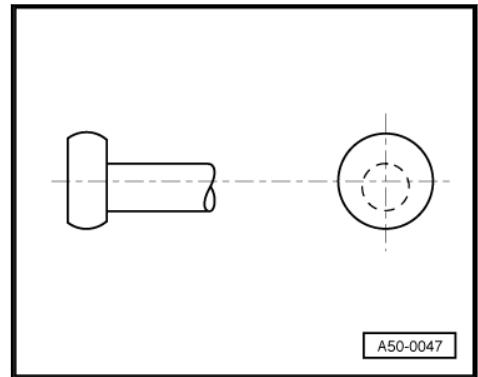
The permitted depth of the rings is $1/4 * \text{height of the head}$.

The fully formed ring is not permitted.



Offset closing head

An offset head is not permitted if the head touches the shaft and the rivet hole is visible.



11.1.4 Kerb-Konus Rivets

Kerb-Konus rivets coated with stainless steel are inserted.



Note

Due to the corrosion risk, stainless steel rivets may not be drilled out or sanded.

Riveting processes

A - Setting the rivet

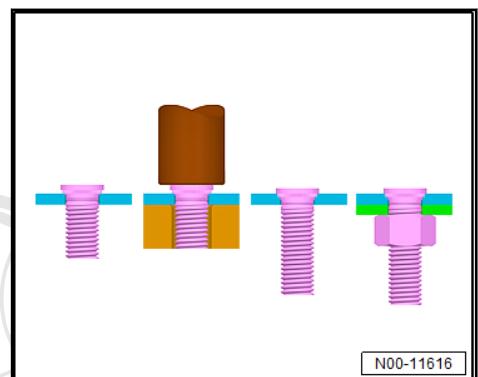
B - Pressing process

C - Inserting and punching out

D - Finished Kerb-Konus rivet connection

Devices

Only the devices approved in the Workshop Equipment Catalog may be used.



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11.2 Flow-Drill Bolts

⇒ “11.2.1 Flow Drill Bolt Connection, Producing, Upper Section Pre-Punched”, page 70

⇒ “11.2.2 Flow Drill Bolt Connection, Producing, Upper Section Not Pre-Punched”, page 70

⇒ “11.2.3 Flow Drill Bolt Connection, Creating, When Replacing Upper and Lower Section”, page 71

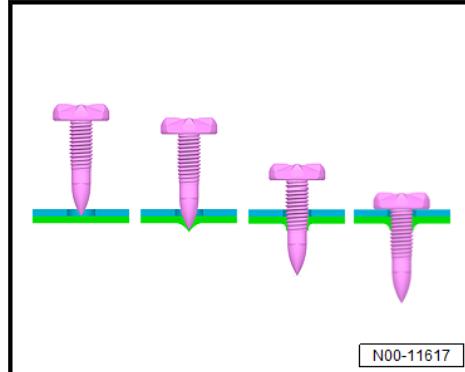
When using flow-drill bolts, the lower component is heated by the frictional heat generated by the turning bolt. Then the self-tapping screw is screwed into the soft aluminum.

Flow-Drill Bolt Connections, Servicing



Note

- ◆ Flow-drill bolts have been introduced on the Audi R8 that can be replaced using the FD Bolt Socket - VAS 852 007A- .
- ◆ The repair concept for the pure aluminum body components is the same as the repair procedures used on previous Audi aluminum vehicles.
- ◆ Using the tool, allows the best use of the threaded connection during repairs.



The production of a flow drill bolt connection is presented in the following based on three examples.

11.2.1 Flow Drill Bolt Connection, Producing, Upper Section Pre-Punched

- Loosen the flow drill bolt threaded connection using a socket for flow drill bolts.
- Remove the upper section.
- Clean the adhesion area with cleaning solution.
- Apply two-part epoxy adhesive to the entire area using a pneumatic adhesive gun.
- Position the new part and tighten using the flow drill bolt socket and tighten new bolts to 5 Nm.

11.2.2 Flow Drill Bolt Connection, Producing, Upper Section Not Pre-Punched

- Loosen the flow drill bolt threaded connection using a socket for flow drill bolts.
- Remove the upper section.
- Insert the hole finder into the existing flow drill bolt threads.
- Position the new part.
- Label the holes in the new part by hitting it lightly with a plastic hammer.



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Allow for the flow drill bolt repair set offset: only make a superficial mark if possible.

- Remove the upper section.
- Drill 7 mm diameter holes in the new part.
- Clean the adhesion area with cleaning solution.
- Apply two-part epoxy adhesive to the entire area using a pneumatic adhesive gun.
- Position the new part and tighten using the flow drill bolt socket and tighten new bolts to 5 Nm.

11.2.3 Flow Drill Bolt Connection, Creating, When Replacing Upper and Lower Section

- Loosen the flow drill bolt threaded connection using a socket for flow drill bolts.
- Remove both sections.
- Using both parts at the same distance as with the original connection, make 4 mm holes.
- Remove the new parts.
- Expand the 4 mm holes in the upper section to 7 mm.
- Clean the adhesion area with cleaning solution.
- Apply two-part epoxy adhesive to the entire area using a pneumatic adhesive gun.
- Position the new part and tighten using the flow drill bolt socket and tighten new bolts to 5 Nm.

Flow Drill Bolt Repair Set

The repair set serves as a means of marking the holes on the new parts where the flow drill bolt threaded connections are used. Using the hole finders, it is possible to transfer the hole positions for the flow drill bolts to the Audi aluminum vehicles if a repair is required. First loosen the old flow drill bolts by using the socket. Then the damaged panel is removed. Now the flow drill bolt repair set is installed in the existing holes in the aluminum panel that was not replaced. Do this using the ring wrench. The new aluminum panel is aligned to the vehicle and attached with crimping pliers. Using light hammer strokes (rubber hammer), the holes from the existing panel will be transferred onto the replacement part with assistance from the flow drill bolt repair set. The replacement part that now contains the marks is removed again. Holes are drilled at the transferred marks. It is then possible to secure the flow drill bolt threaded connections of the new part to the body using the socket

Devices

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11.3 Clinching

Clinching is a press-joining process to connect sheet metal without using additional materials. One can expect to apply it to joining procedures as well as to reforming procedures, because the connection is attained by reforming the material.

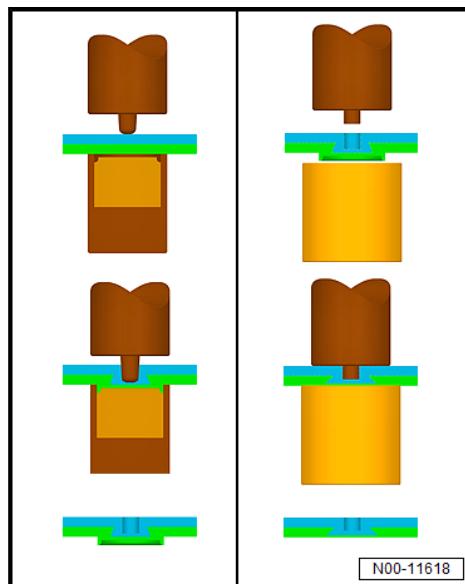
Repair Information

- First make separating cuts, if necessary.
- Remove the old flange by peeling.
- Align the remaining flange.



Adjust the rivet tool to material thickness for all procedures.

- Remove the damaged part, separate with a chisel if necessary.
- Fit new parts, and install solid or pop rivets based on the repair manual "Body Repair".



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12 Separation Technologies in Body Repair; Application

[⇒ "12.1 Drilling", page 73](#)

[⇒ "12.2 Sawing", page 73](#)

[⇒ "12.3 Sanding", page 73](#)

[⇒ "12.4 Milling", page 74](#)

12.1 Drilling

Drilling is used to loosen resistance weld spots and rivets. Make sure no underlying components are damaged while drilling. When loosening two or more welded connections, the panel remaining on the vehicle may not be impaired more than necessary. After drilling, carefully remove any drill shavings from the cavities (vacuum).

12.2 Sawing

The technician will decide between the two established device types for sawing:

- ◆ Short stroke pneumatic saw
- ◆ Oscillating saw

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Advantages of the short stroke pneumatic saw:

- ◆ Faster separation.
- ◆ Possible to saw curves.
- ◆ Can also be inserted at sharply angled profiles.

Advantages of the oscillating saw:

- ◆ Clean, straight cuts.
- ◆ Low penetration depth, therefore it is particularly suitable for double-layer panels.



Note

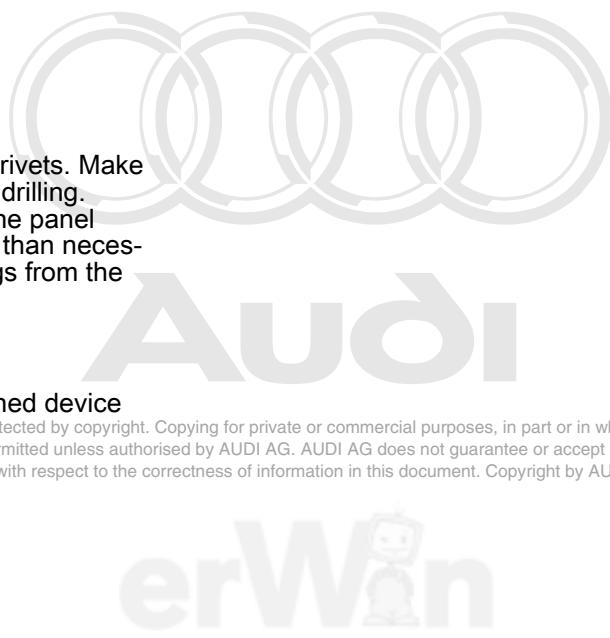
After sawing, carefully remove any saw shavings from the cavities (vacuum).

12.3 Sanding

Sanding can be a very favorable alternative to drilling, especially when loosening high-strength welded connections. Weld points, laser weld connections, or brazed seams can be loosened very efficiently by sanding. Also make sure here that the underlying materials are not impaired or damaged any more than necessary.

Disadvantages of sanding:

- ◆ Due to the flying sparks, extensive protective measures are necessary on the vehicle and in the surrounding area.
- ◆ Higher temperature build-up than when drilling, thus more damage to residual material and corrosion protection.

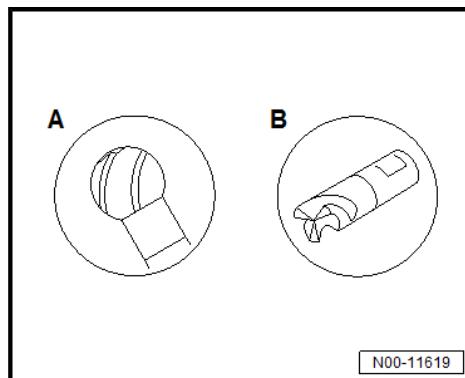


12.4 Milling

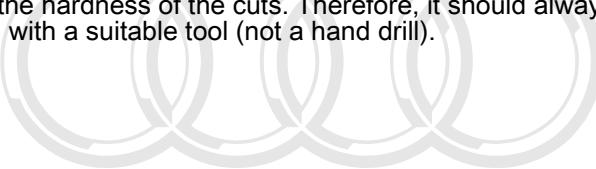
In body repairs, the technician decides between a ball end nose mill -A- and a BTR mill -B-.

A ball end nose mill is used if the spacial conditions do not allow the BTR mill to be used for loosening weld points.

When working with the BTR mill, it must be made sure that cuts do not tilt into the high-strength steel. They can break easily due to the hardness of the cuts. Therefore, it should always be worked with a suitable tool (not a hand drill).



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13 Surface Repairs

- ⇒ [“13.1 Dent Removal Techniques, Steel Panel”, page 75](#)
- ⇒ [“13.2 Dent Removal Procedures, Aluminum Panel”, page 76](#)
- ⇒ [“13.3 Metal and Aluminum Body Filler, Handling”, page 77](#)
- ⇒ [“13.4 Unleaded Tin, Handling”, page 78](#)
- ⇒ [“13.5 Accurately Contoured Surface Definition, Transfer to Paint Shop”, page 78](#)



Note

Generally, the inner corrosion protection must be paid attention to during all bulge corrections.

13.1 Dent Removal Techniques, Steel Panel

- ⇒ [“13.1.1 Classic Dent Removal Procedure, with Paint Damage”, page 75](#)
- ⇒ [“13.1.2 Pressing Bulge Correction Procedure, without Paint Damage”, page 75](#)
- ⇒ [“13.1.3 Exterior Dent Corrections / Pulling Dent Removal Procedure”, page 76](#)

13.1.1 “Classic” Dent Removal Procedure, with Paint Damage

The classic dent removal method using a hammer and counterhold is rarely still used on modern vehicle bodies.

The disadvantage of this technique is that usability is limited (depending on construction) as well as the overextension of materials required by this method. The resulting excess of material must often be thermally reduced, which in turn results in considerable disadvantages for the material strength and corrosion protection.

13.1.2 “Pressing” Bulge Correction Procedure, without Paint Damage

This dent removal method that does not cause paint damage is mostly used for minor parking and hail damage. Here the dent is softly pressed outward from the inside. The pressing is done circularly around the center of the dent in multiple stages, so that the paint can also be reshaped without a formation of cracks.

A - Pressing Set Example

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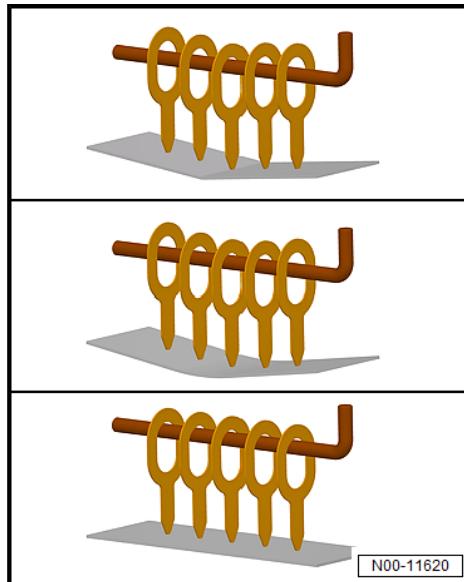


13.1.3 "Exterior Dent Corrections / Pulling" Dent Removal Procedure

The exterior dent removal method is used as a bonding technique without damage as well as a method with paint damage, due to pulling aids being attached. This method selection therefore depends on the type of damage. For both procedures, the dent is pulled out of the panel from the outside. The long reshaping process significantly reduces the tension in the material structure. It is also referred to as "soft" or "no-shock" reshaping.

Advantages of these bulge removal methods:

- ◆ Overstretching of material is reduced
- ◆ Minimal corrosion protection damage.
- ◆ Minimal disassembling of the vehicle.
- ◆ Maintains the original joint (compared to component replacement).



13.2 Dent Removal Procedures, Aluminum Panel



Note

Aluminum parts must be covered when sanding and welding steel parts. Any steel shavings that contact aluminum must be immediately removed or else contact corrosion can occur.



Note

- ◆ Use separate tools for steel or aluminum.
- ◆ Recommendation: Aluminum tool kit in the tool cart (refer to Workshop Equipment Catalog)

The dent removal techniques for aluminum components are not fundamentally different than those for steel components. However, due to the different material properties, several points must be noted:

- ◆ The risk of material expansion is greater with aluminum than with steel.
- ◆ Sharp-edged and hard dent removal tools (for example, steel hammer) should be avoided and should be replaced with plastic, wood or aluminum hammers.
- ◆ Flattening procedures on aluminum panels begins, contrary to steel panels, in the center of the dent.
- ◆ If the material stretches, this can be corrected by applying heat and retracting.

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Note

Do not exceed the maximum heat of 150° C during retraction; otherwise, the component may become damaged.



Note

Replace the part if a tear forms when removing dents.

Controlling Temperature When Heating

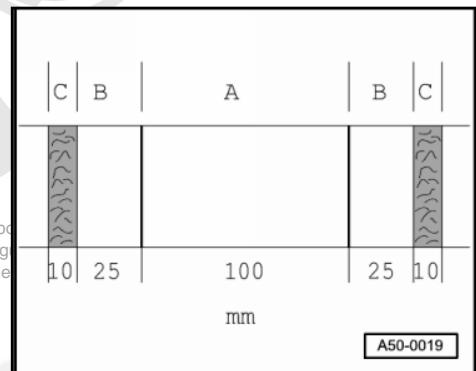
No tempering colors can be recognized when heating aluminum. Therefore, the temperature must be determined using thermo-strips.

Thermo-strips change color at specific temperatures.

A - Warming area

B - Free zone

C - Thermo-strips



13.3 Metal and Aluminum Body Filler, Handling

Using metal and aluminum body filler has many advantages:

- ◆ Very good adhesive properties on bare surfaces
- ◆ Higher coat strengths are possible than with polyester body filler.
- ◆ When handles correctly, there is a low tendency of "shrink-ing" or "sagging".
- ◆ Due to the low application of heat, they can also be used in areas with adhesive.
- ◆ No visible marks in the overlapping areas.



Note

Only approved body filler materials may be used.



Note

- ◆ Note the handling information on the containers.
- ◆ Adhesive residue or similar material must be completely removed from the joints before applying the body filler.
- ◆ The surface temperature must be checked when drying with the infrared heater.
- ◆ Self-regulating infrared heaters tend to have measurement errors on small surfaces, which can lead to component damage.

13.4 Unleaded Tin, Handling



Note

- ◆ *Handling tin, even unleaded tin, is no longer permitted.*
- ◆ *To create a surface with correct contours, use the materials listed. Refer to ⇒ "13.3 Metal and Aluminum Body Filler, Handling", page 77 .*

13.5 “Accurately Contoured Surface” Definition, Transfer to Paint Shop

The contoured surface is a surface with the dimensional accuracy of the edges and seams to the surface.

It is specified when:

- ◆ Any surfaces or parts that have been worked on, such as removing dents, welding or spackling, must be dry sanded with minimum P 80 grit sandpaper.
- ◆ The vehicle paint shop technician must then re-create the respective surface in a maximum of two steps.



Note

Only approved body filler materials may be used. Neither unleaded nor leaded alluvial tin is approved for any procedure.



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14 Straightening Procedures on Vehicle Structure

⇒ ["14.1 Straightening", page 79](#)

⇒ ["14.2 Separating Cuts", page 79](#)

⇒ ["14.3 Body Sub-Parts and Partial Sections", page 79](#)

14.1 Straightening

Body and floor assembly in series production are produced predominantly from cold-formed deep-drawing sheet metal. For this reason, reshaping accident damage should be carried out in the same way.

If the size of the damage does not allow it to be reshaped against the direction of damage, the damaged part must be removed after straightening the connecting surfaces.

14.2 Separating Cuts

Separating cuts that influence the fatigue strength of the body and the operational safety and road safety of the vehicle must be carried out according to the specifications of the applicable body repair manual.

14.3 Body Sub-Parts and Partial Sections

"Sub-parts" include sections of individual parts (for example, front and rear end points) that are delivered pre-cut from the replacement parts distribution center.

- ◆ In contrast to this, "partial sections" are to be cut out from "replacement parts". In individual cases, work is to be performed exactly according to the methods described and represented in the body repair manual.
- ◆ Because the use of "sub-parts" or "partial sections" as well as special resources influence repair times, the special resources are included separately in the repair description.

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15 Corrosion Protection

⇒ “15.1 Corrosion Protection on Attachments and Welded Parts”, page 80

⇒ “15.2 Sealing Cavities”, page 80

The standard corrosion protection should be reapplied after servicing with the materials specified by the manufacturer.

The corrosion protection used in production is described in the general and vehicle-specific ⇒ Paint Manual .

15.1 Corrosion Protection on Attachments and Welded Parts

⇒ “15.1.1 Contact Corrosion”, page 80

- ◆ Prime bare panel surfaces immediately after the repair.
- ◆ Holes must be deburred.
- ◆ Always apply welding primer/structure adhesive (according to the repair manual) to both sides of the welding flange.
- ◆ Prime the weld area on inside and outside before sealing.
- ◆ Apply sealant only to primed panels.
- ◆ Completely seal panel overlap, panel edges, butt joints, weld seams, etc. with sealant.
- ◆ The weld seams may not be sanded otherwise the strength of the weld seam will be impaired.
- ◆ Reproduce the paint structure as described in the paint manual.
- ◆ Restoring the underbody protection with long-term underbody protective material.
- ◆ Apply protective material to all cavities in repair area after finish painting.
- ◆ Protective material must be completely applied on separation cuts (for example, in side panel).
- ◆ Open water drains after cavity sealant material dries.

15.1.1 Contact Corrosion

Contact corrosion can occur if incorrect connecting elements (bolts, nuts, washers, etc.) are used.

For this reason, only fasteners with a special surface coating may be installed.

Furthermore, only rubber/plastic parts and adhesive made of electrically non-conductive materials are used. © Copyright by AUDI AG. Copying for private or commercial purposes, in part or in whole, is not permitted unless authorised by AUDI AG. AUDI AG does not guarantee or accept any liability

If there are doubts about the suitability of parts, use new parts.

15.2 Sealing Cavities

The corrosion protection used in production is described in the general and vehicle-specific ⇒ Paint Manual .

 Note

- ◆ Before starting to apply, it is necessary to read the safety measures and advice in the safety data sheet.
- ◆ Even for products which are not required to be labeled by law, the usual safety measures must be observed for chemical emissions.
- ◆

 Note

Depending on the type of the cavity to be treated, the drying phase can last several days. Ensure that the vehicle is well ventilated during the drying process.

 Note

- ◆ Do not spray functional parts such as the brake and exhaust systems.
- ◆ Rubber and plastic parts should also not be sprayed.

Cleaning

- ◆ Dripping cavity sealant can be easily wiped away.
- ◆ Adhesive remover should be used to clean off any drips on material.
- ◆ Larger surfaces can be cleaned with a steam cleaner. Splashes on painted surfaces should be removed immediately.



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16 Plastic Repair

- ⇒ “16.1 Dents, Servicing”, page 82
- ⇒ “16.2 Scratches, Servicing”, page 84
- ⇒ “16.3 Cracks, Servicing, Up to 100 mm Long”, page 85
- ⇒ “16.4 Holes, Servicing, Up to 30 mm Diameter”, page 86
- ⇒ “16.5 Plastic Repair (GFK)”, page 87



Note

Follow the general accident prevention tips. Do not repair safety-related components whose function can no longer be guaranteed after servicing, for example, those that absorb impact.

Plastic repairs with the plastic repair kit refer to servicing painted plastic body components such as the bumper and mirror housing. Before repairing, check carefully to see if the service can be performed and if it makes sense economically (repair/new part).

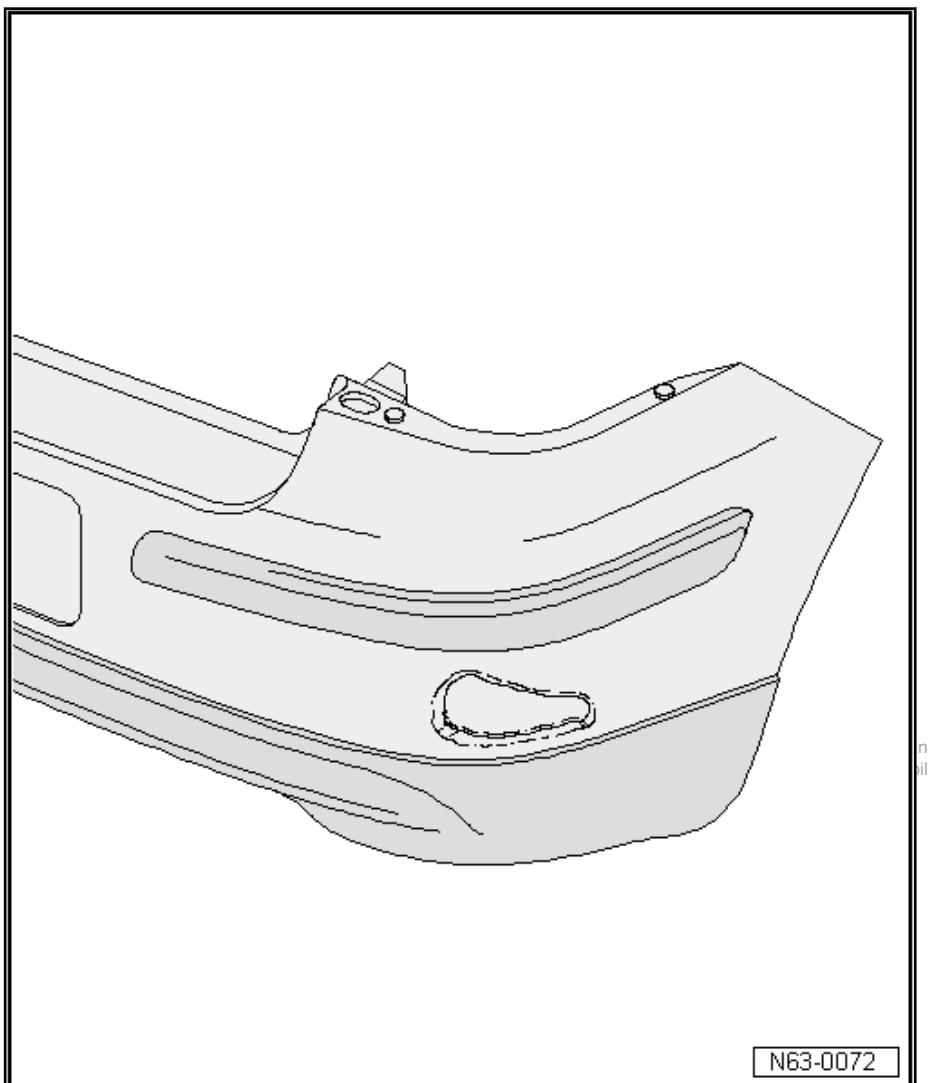
Plastic components with a structured surface can be serviced. However, the quality standard of the surface will not be at the same level as that of a new part.

16.1 Dents, Servicing



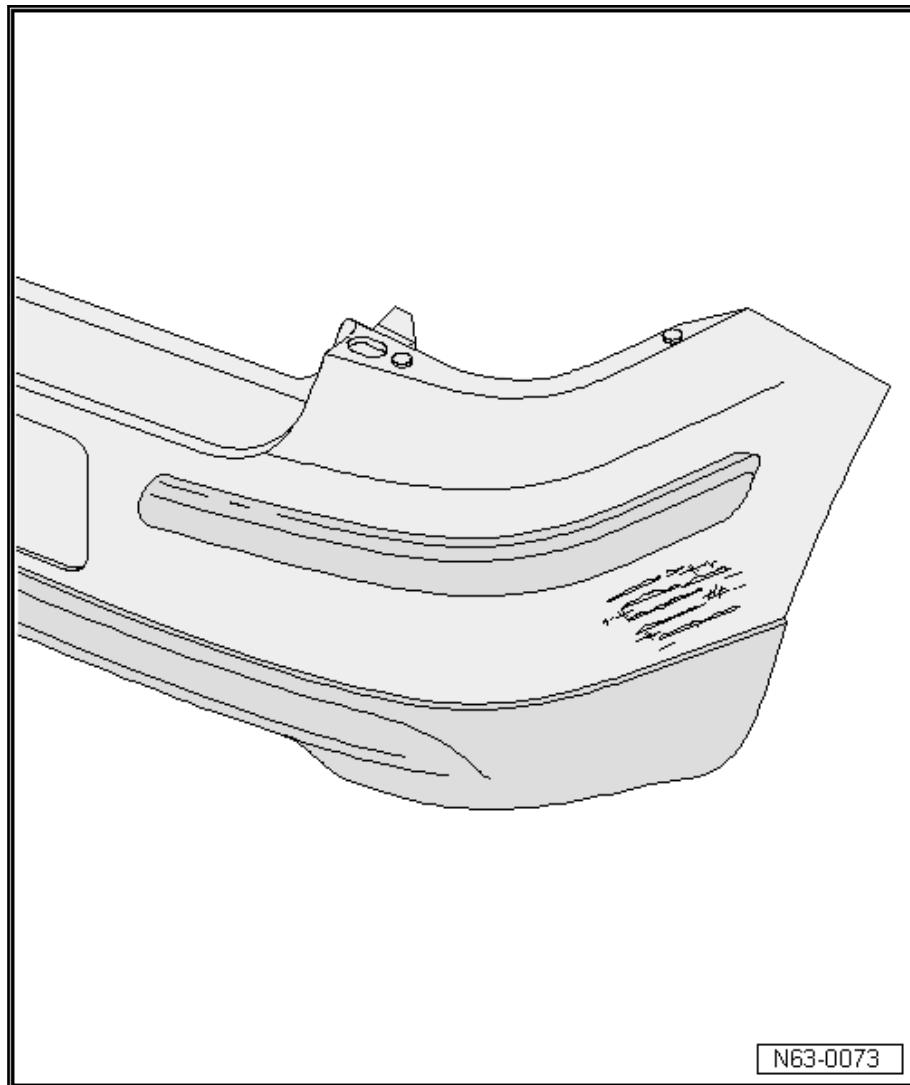
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- First clean and dry the repair part.
- Warm the dented area with a hot air gun until it can be pressed out with a suitable tool.
- Now sand the dented area with 120 grit sandpaper.
- Then clean the repair area with cleaner. Flash-off time is five minutes.
- Now spray lightly with bonding agent and allow 10 minutes flash-off time.
- Now any uneven areas can be filled with adhesive and smoothed out with a spatula.
- Curing can be accelerated with an infrared heater. Set it for 15 minutes at 60°-70 °C.
- Now sand the repair location down with 120 grit sandpaper.
- Now remove the sanding dust.
- Now spray lightly with bonding agent and allow 10 minutes flash-off time.
- Create the paint structure according to the paint repair manual.

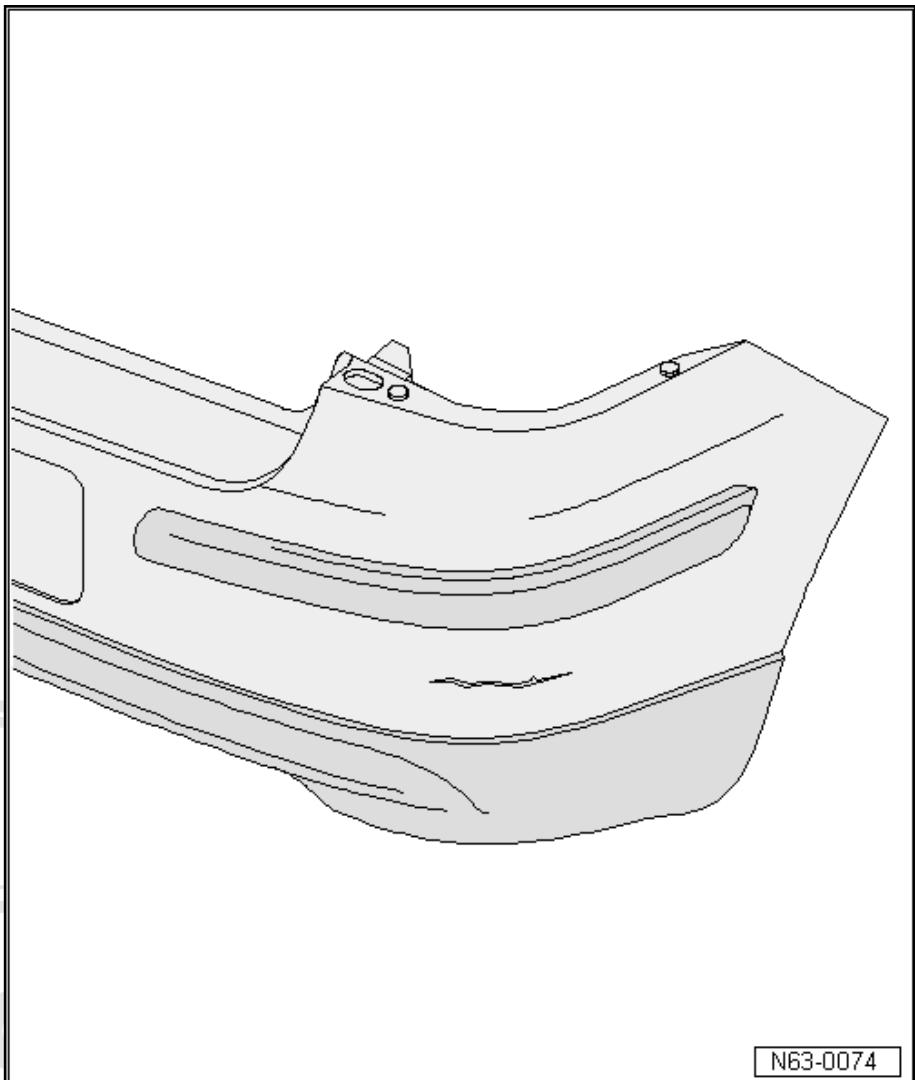
16.2 Scratches, Servicing



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- First clean and dry the repair part.
- Remove stuck material with 80 grit sandpaper.
- Then clean the repair area with cleaner. Flash-off time is five minutes.
- Now spray lightly with bonding agent and allow 10 minutes flash-off time.
- Now any uneven areas can be filled with adhesive and smoothed out with a spatula.
- Curing can be accelerated with an infrared heater. Set it for 15 minutes at 60°-70 °C.
- Now sand the repair location down with 120 grit sandpaper.
- Now remove the sanding dust.
- Now spray lightly with bonding agent and allow 10 minutes flash-off time.
- Create the paint structure according to the paint repair manual.

16.3 Cracks, Servicing, Up to 100 mm Long

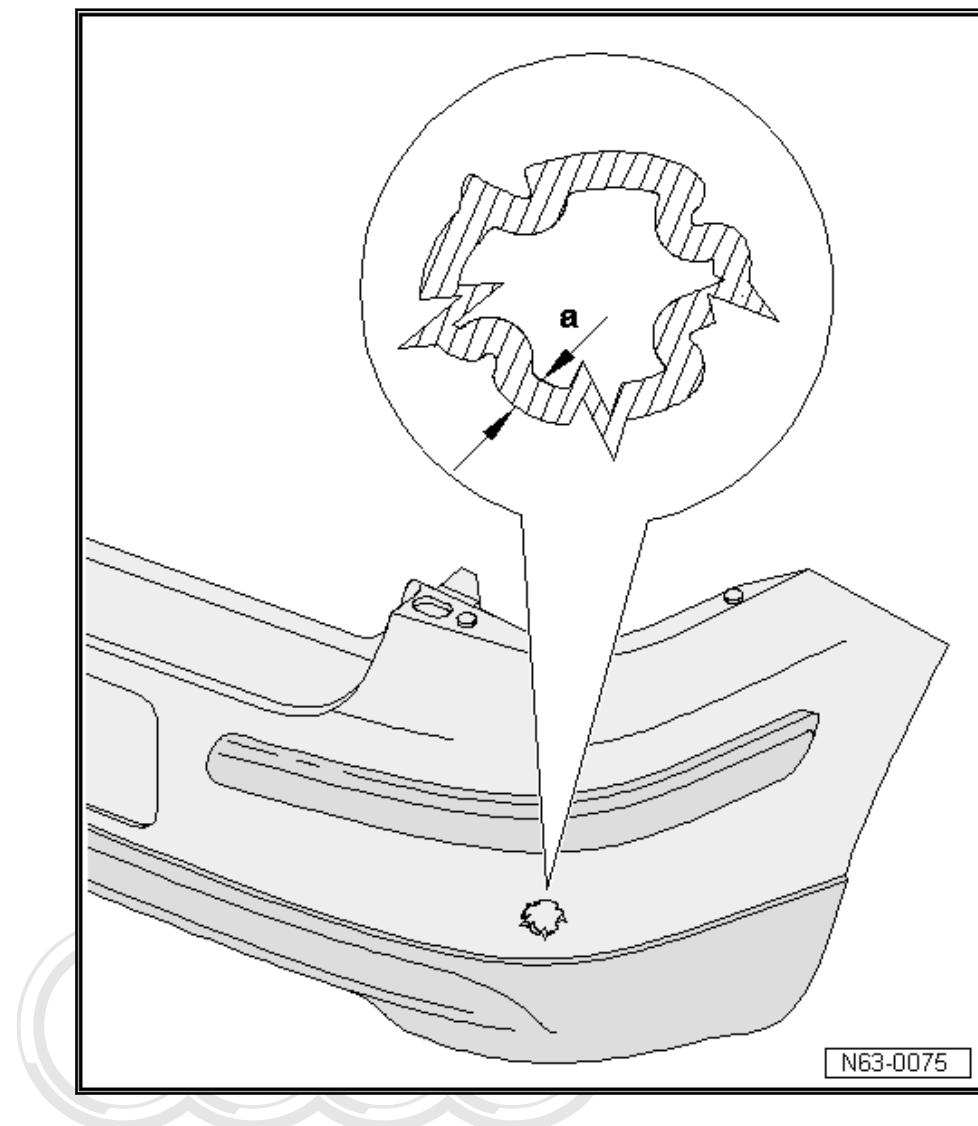


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- First clean and dry the repair part.
- Uneven areas can be removed through expanding by drilling the crack (5 mm) and sanding it in a V-formation.
- Then clean the repair area with cleaner. Flash-off time is five minutes.
- Now spray lightly with bonding agent and allow 10 minutes flash-off time.
- First, install a reinforcement mat on the back of the repair part using adhesive so that it overlaps the damaged parts by at least 20 mm.
- Curing can be accelerated with an infrared heater. Set it for 15 minutes at 60°-70 °C.
- Then, the front side of the sanded area can be filled with adhesive and smoothed with a spatula.
- Curing should be accelerated on the front side with the infrared heater as explained earlier.
- Now sand the repair location down with 120 grit sandpaper.

- Now remove the sanding dust.
- Now spray lightly with bonding agent and allow 10 minutes flash-off time.
- Create the paint structure according to the paint repair manual.

16.4 Holes, Servicing, Up to 30 mm Diameter



- First clean and dry the repair part.
- Using 120 grit sandpaper, sand the repair location in a funnel shape 10-20 mm, dimension a.
- Now spray lightly with bonding agent and allow 10 minutes flash-off time.
- Then rough up the area with 120 grit sandpaper.
- Then clean the repair area with cleaner. Flash-off time is five minutes.
- Now spray lightly with bonding agent and allow 10 minutes flash-off time.

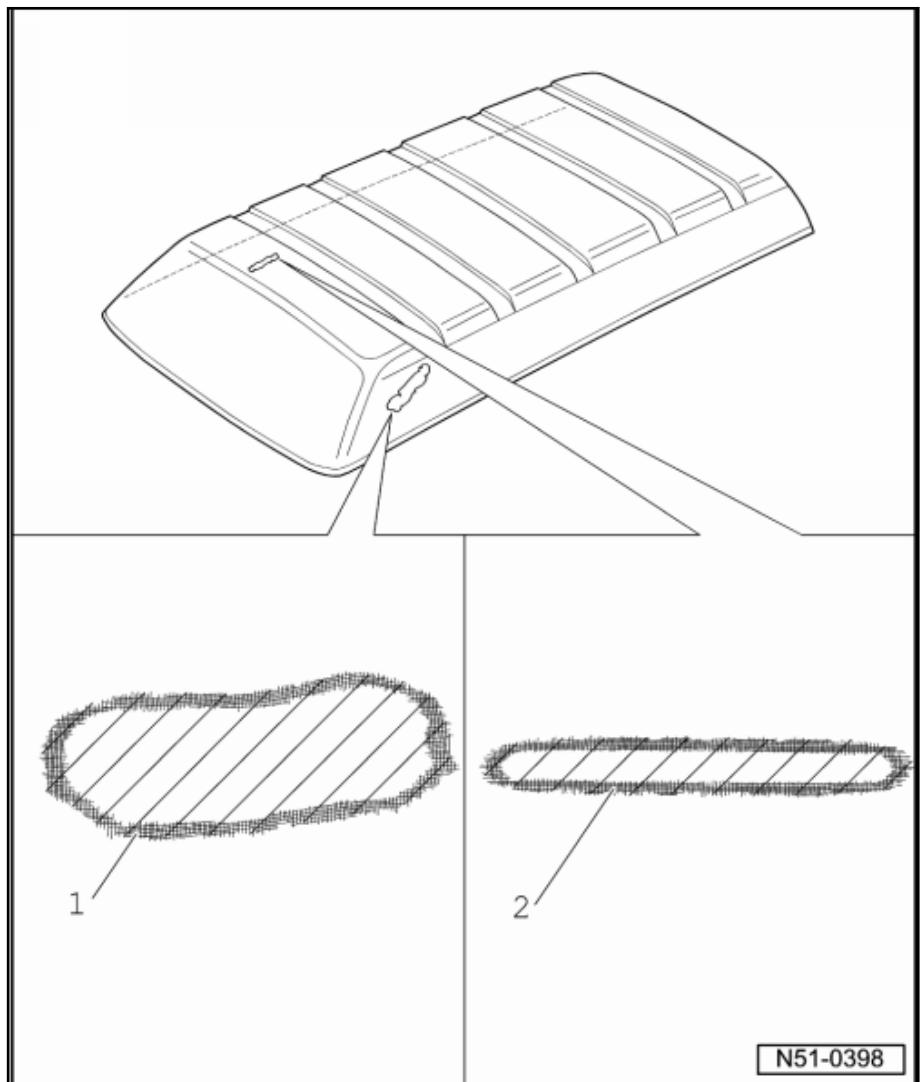
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- First, install a reinforcement mat on the back of the repair part using adhesive so that it overlaps the damaged parts by at least 20 mm.
- Curing can be accelerated with an infrared heater. Set it for 15 minutes at 60°-70 °C.
- Then, the front side of the sanded area can be filled with adhesive and smoothed with a spatula.
- Curing should be accelerated on the front side with the infrared heater as explained earlier.
- Now sand the repair location down with 120 grit sandpaper.
- Now remove the sanding dust.
- Now spray lightly with bonding agent and allow 10 minutes flash-off time.
- Create the paint structure according to the paint repair manual.

16.5 Plastic Repair (GFK)

⇒ “16.5.1 Crack Repair Procedure, Servicing”, page 88

⇒ “16.5.2 Surface Damage Repair Procedure, Servicing”, page 89



 Note

Follow the general accident prevention tips. Do not repair safety-related components whose function can no longer be guaranteed after servicing, for example, those that absorb impact.

1- Crack

- ◆ Fiber glass mat, polyester resin and hardener

2- Surface damage

- ◆ Fiber glass reinforced polyester resin, hardener

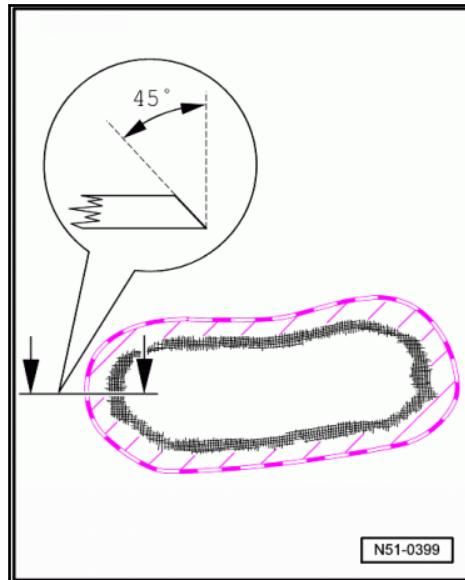
 Note

Follow the usage instructions from the manufacturer when working with the materials.

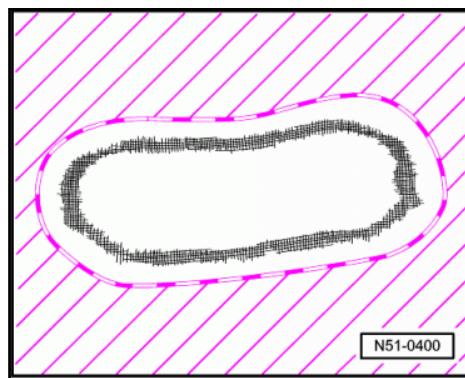
16.5.1 “Crack” Repair Procedure, Servicing



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- Sand off the edge of the crack all around at approximately a 45° angle.

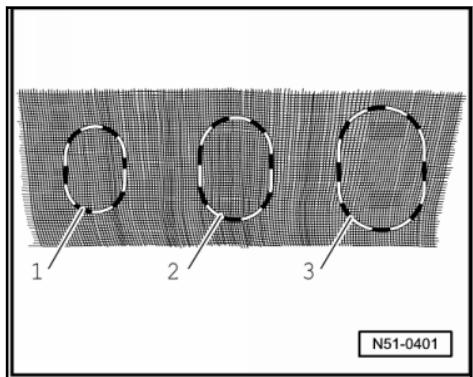


- Sand the surface down approximately 100 mm all around the crack -shaded area- with 150 grit sandpaper and clean with silicone remover.
- Cut the three fiber glass mats: -1- approximately 25 mm overlapping the crack, -2- approximately 50 mm overlapping, -3- approximately 75 mm overlapping.



Note

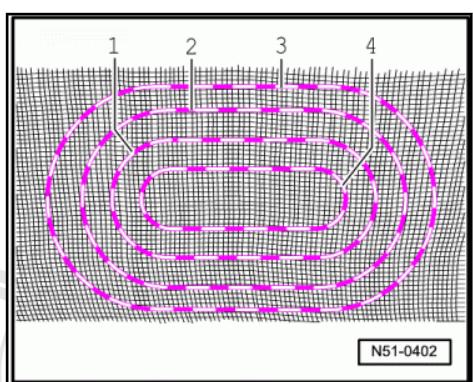
With larger cracks, creating a support from styrofoam is recommended. Wrap the styrofoam with plain, commercially available PE plastic film to avoid contact with polyester resin. Then secure the finished support on the inside of the crack with adhesive tape.



N51-0401

Install the fiber glass mats

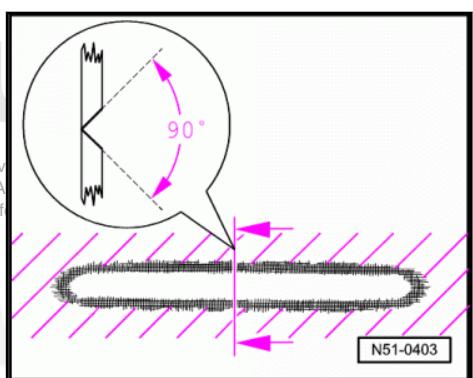
- Mix the polyester resin (follow the manufacturer's instructions).
- Apply the polyester resin lightly to the crack.
- Saturate the smallest fiber glass mat -1- with polyester resin and apply to the crack -4-.
- Remove air bubbles in the polyester resin with a pointed tool immediately after applying.
- After hardening, sand the material applied with 120 grit sandpaper.
- Clean the repair location with silicone remover.
- Repeat the procedure with the second -2- and third -3- fiber glass mats.



N51-0402

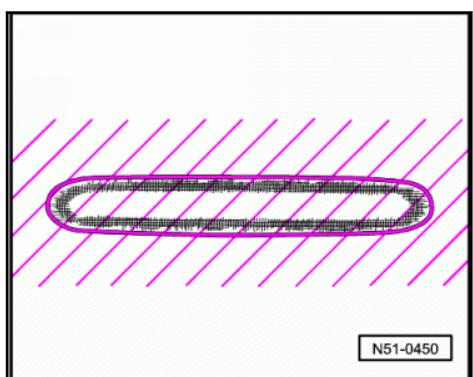
16.5.2 "Surface Damage" Repair Procedure, Servicing

- Grind down the surface damage in a V-shape.
- Sand the surface approximately 50 mm all around the surface damage -shaded area- with 150 grit sandpaper.



N51-0403

- Clean the repair location with silicone remover.
- Mix fiber glass reinforced polyester resin (follow the manufacturer's instructions) and apply it to the repair location -shaded area-.
- After curing, sand down the repair location and clean with silicone remover.



N51-0450

17 Glass Repair

⇒ “17.1 Windshield Repair”, page 90

⇒ “17.2 Required Special Tools and Equipment”, page 94

⇒ “17.3 Repair Description”, page 96

17.1 Windshield Repair

⇒ “17.1.1 Requirements”, page 91

⇒ “17.1.2 Repair Description”, page 94

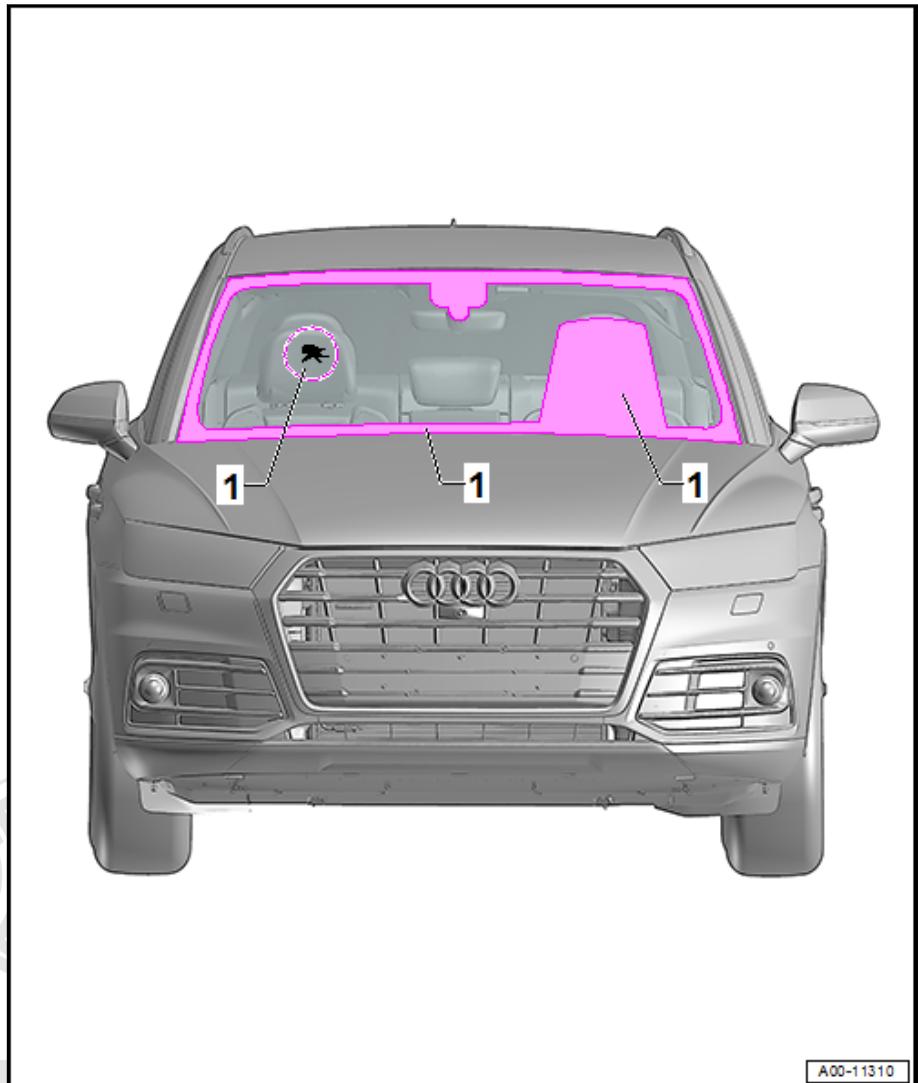
Aside from replacing bonded windshields, there is the less expensive option of repairing a windshield that has been damaged by a stone, under certain conditions.

Tinted windshields, windshields with colored liners or insulated glass, and windshields with a heat function can also be repaired, because the tint and heat are emitted by the PVB interlayer.

Repairing the windshield is preferred to replacing it under the following conditions.

- ◆ It is legally prohibited to perform repairs within the visual field of the driver. This is understood as 290 mm wide strips, parallel to the center of the vehicle longitudinal axis, going out from the center of the steering wheel, and bordered by the upper and lower edge through the wiper field.
- ◆ The damaged area must not be larger than 25 mm in diameter.
- ◆ The windshield must not have more than three damaged areas.
- ◆ Only damage on the outer edges of the window can be repaired. The inside of the window and the intermediate plastic film must not have any damage. Chippings on the windshield glass are not stone impacts and therefore can also not be repaired.
- ◆ If no (visible) moisture or dirt is in the damaged location.
- ◆ The damage location must not lie within the driver's direct field of vision -1-. This field corresponds to a strip approximately 29 cm wide (DIN A4 format across) central to the driver's line of sight in direction of travel, bordered above and below by the windshield washer field.
- ◆ Cracks radiating out from the damage location must not be longer than 50 mm and/or continue outward into the peripheral area.
- ◆ The damaged location and/or cracks must be at least 10 cm away from the window edge.

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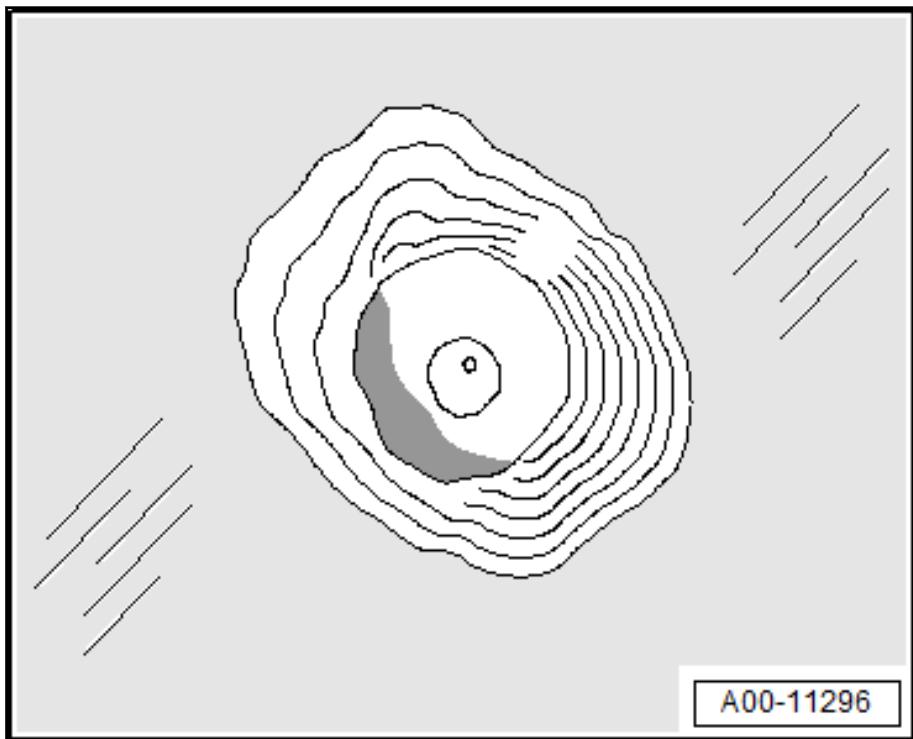


17.1.1 Requirements

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The following damage may be repaired as long as it is not in the field of vision or in the peripheral areas of the windshield:

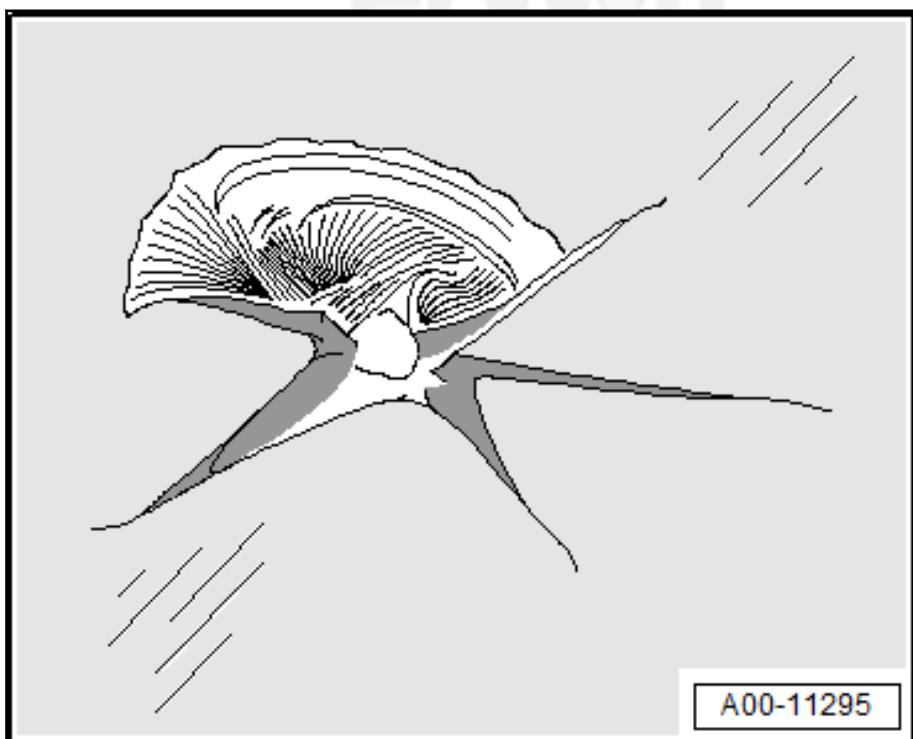
Bullseye



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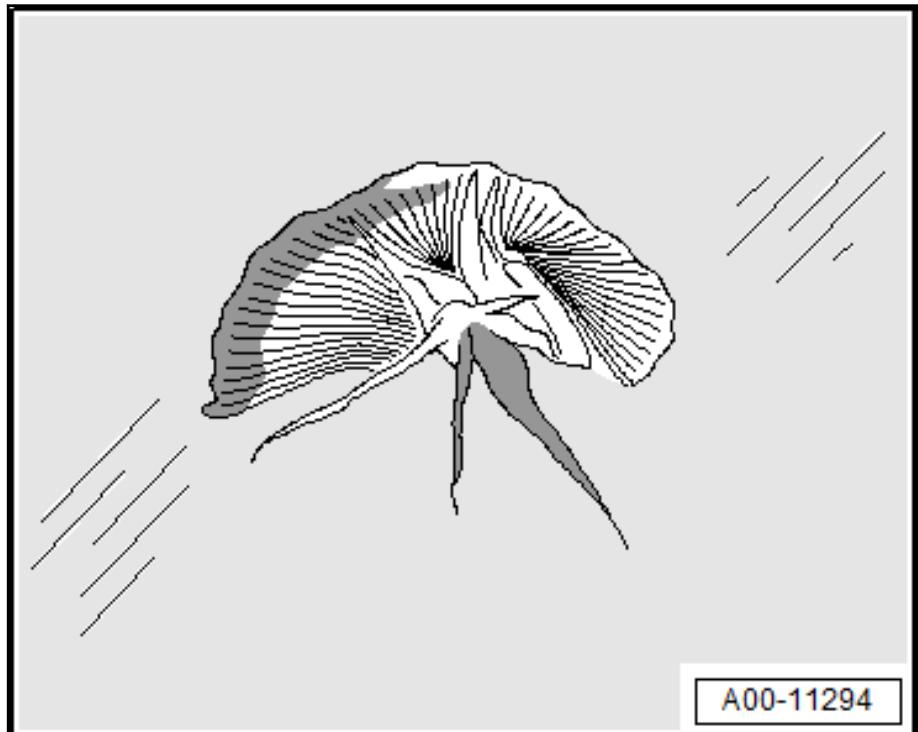
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Star break

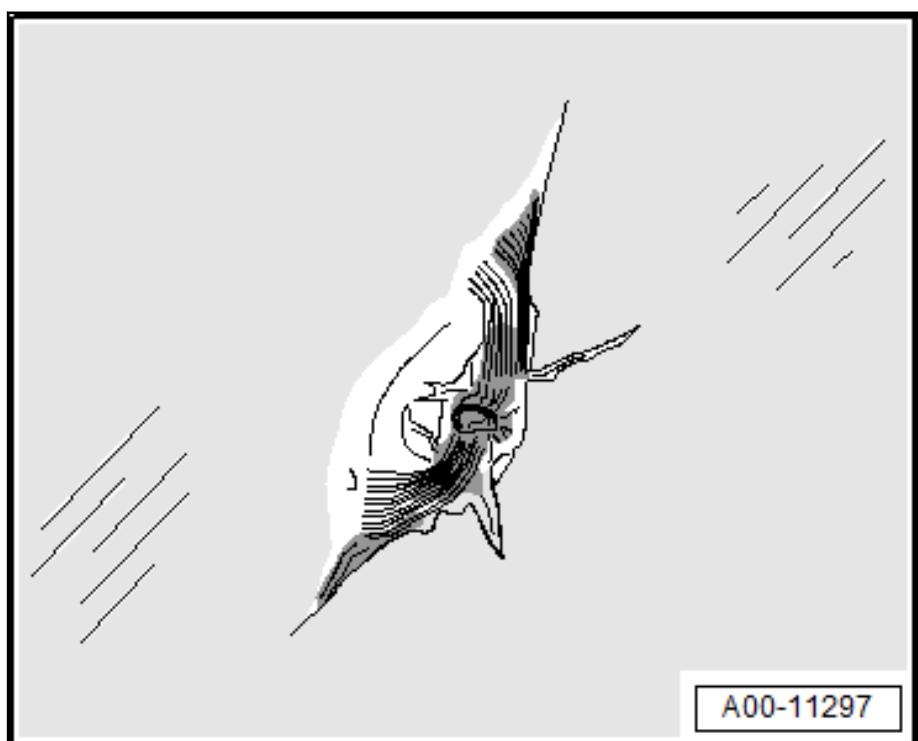


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Combination



Half moon



erWin

17.1.2 Repair Description



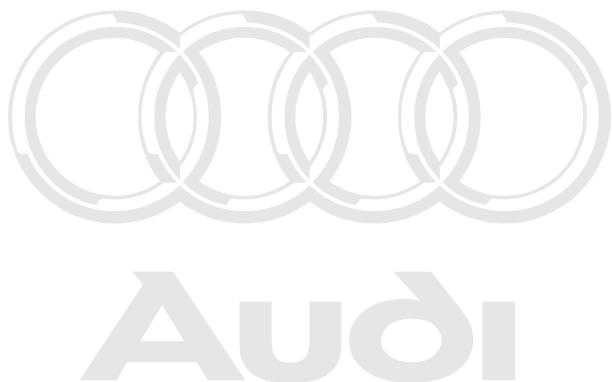
Note

- ◆ After the repair, the vehicle is ready to operate again without any waiting time.
- ◆ Traces of fractures cannot be removed completely with many types of breaks but they do not affect the results of the repair.
- ◆ After repair, the window is as strong as normal and further cracks are prevented by the molded and hardened plastic resin. The hardened resin is colorless and has the same refractive index as glass.

17.2 Required Special Tools and Equipment

- ◆ Windscreen Repair Set - VAS 6092A-

Contains the following tools:

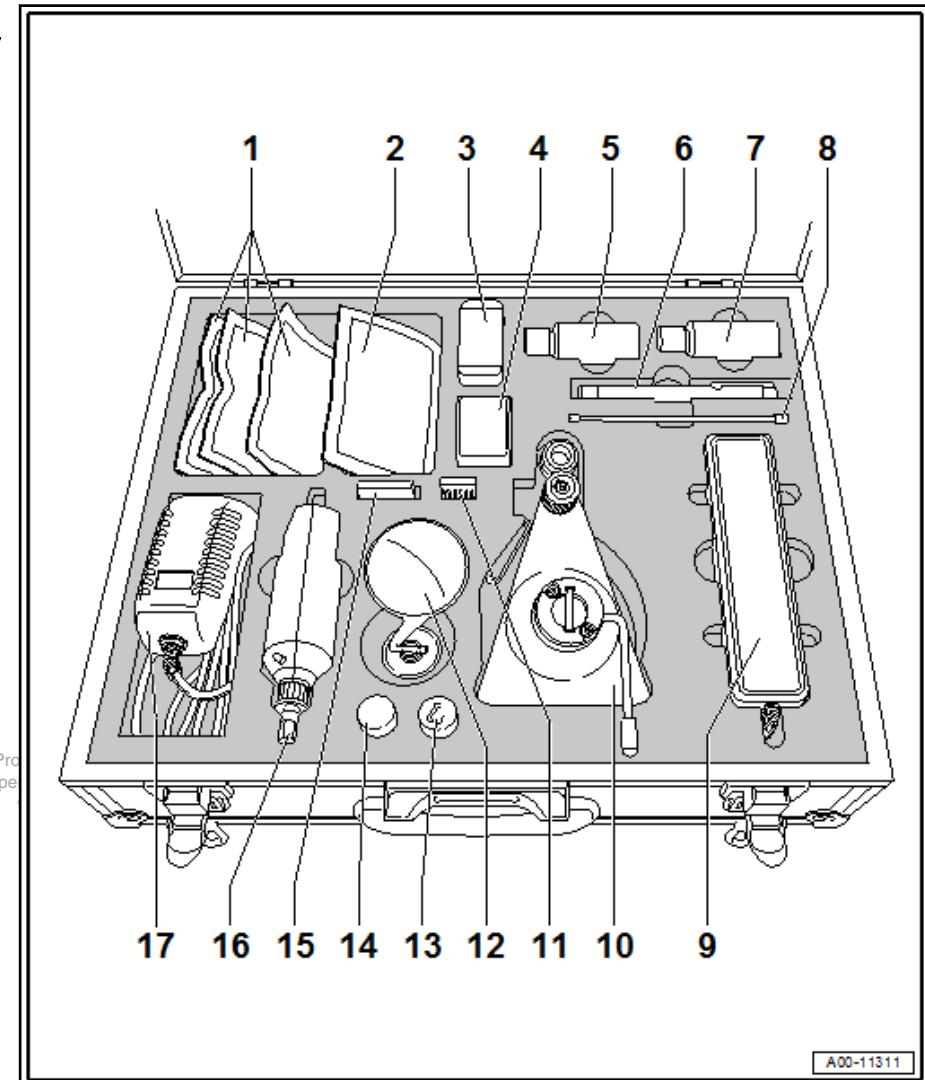


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1 - Quantity: 3 Repair Resin
- approximately 10 repairs per pack

2 - Finishing Resin - for sealing the stone impact

3 - Quantity: 10 Scraper Blades



Note

Only use the correct and undamaged scrapers.

4 - Hardening Film

5 - Vacuum Gel

6 - Polish

7 - Mini Lamp

8 - Carbide Pin

9 - LED UV Lamp to harden the stone impact

10 - Tool carrier

11 - Quantity 2x Glass Drill Milling Cutter 1.2 mm

12 - Scraper Blade Holder

13 - Inspection Mirror

14 - Polishing Head

15 - Stone Chip Finder

16 - Drill

17 - Volt Cable (Cigarette Lighter Cable)

17.3 Repair Description

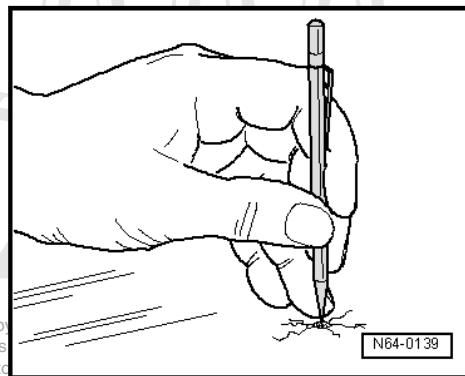
- Repairs should not take place in direct sunlight.
- The repair location must be approximately at room temperature.
- The work area must be protected against moisture.

Cleaning

- Use the glass cleaner to clean the window glass around the damage location without wiping over the point of impact.
- Remove any loose glass chips and contamination in the stone impact using the carbide pin, but do not enlarge the impact crater unnecessarily.

The more glass that is missing on the surface, the stronger the visual effects of the repair will be.

Inspection Mirror, Securing



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- Secure the inspection mirror -2- from the interior on the window glass so that the procedure can be monitored from the outside.

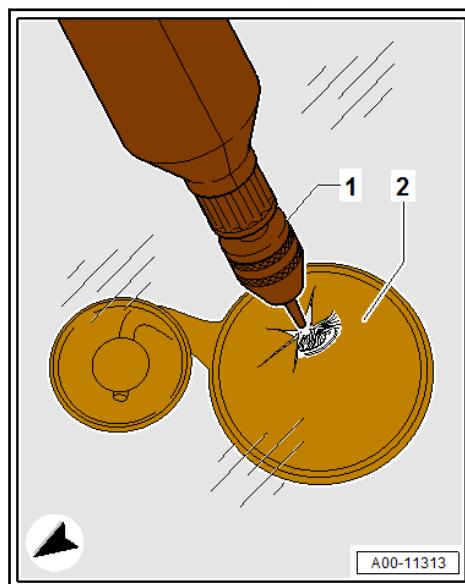
Drilling



Note

Always hold the drill with two hands! This is the only way to ensure the exact positioning of the hole. Overheating the drill can be prevented by short breaks when drilling (every 2 seconds).

- Remove any possible moisture with suction hooks while helping with hair dryer from inside. Stop the repair if moisture cannot be removed.



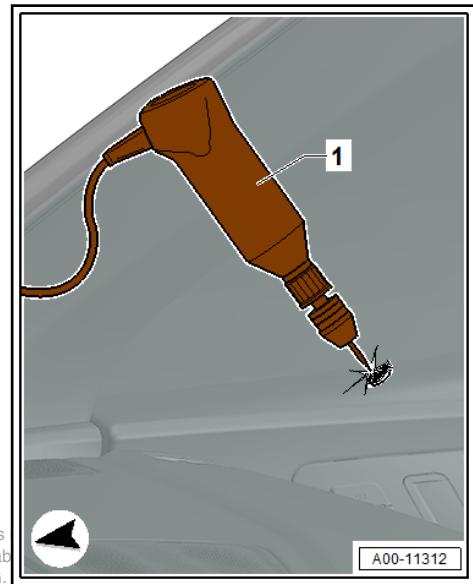
A00-11313

- Insert the carbide drill bit in the drill -1- and drill a 1 mm deep hole in the center of the damage location vertical to the window glass. The drill depth is reached when the ball of the drill meets the glass.

Tool Holder, Securing



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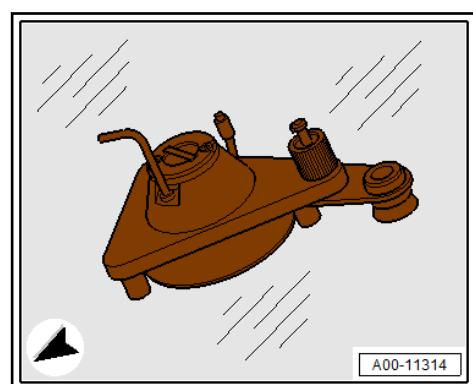


- Coat the suction area of the tool holder with vacuum gel. This allows a position correction of the secured tool holder. By moving the suction cup lever toward the rear, the tool holder must be secured on the window glass so that the injector hole is located exactly over the damage location.

Injector, Filling

- Remove the piston approximately 4 to 5 mm from the cylinder. Fill the working chamber of the injector -2- completely without bubbles with repair resin.

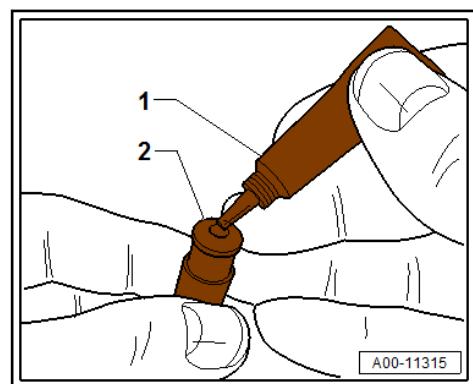
The repair resin -1- is hardened by UV and must for this reason be protected from UV rays.



- Wait until resin flows into the rubber seal.

Injector, Positioning (Pressure Phase)

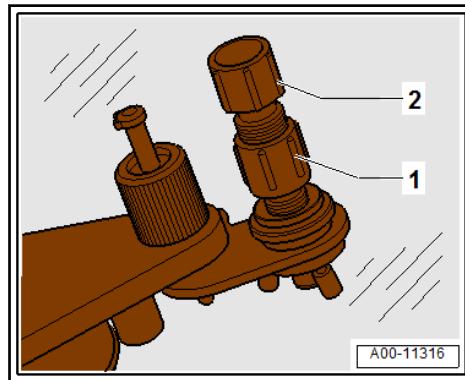
- Install the piston -2- of the injector -1- in the cylinder until it can be seen in the inspection mirror how the opening of the seal slightly (by approximately 1 mm) enlarges. The repair resin is pressed into the damage location by the pressure created in the working chamber. The air is now compressed in the stone impact. This can be seen by the black air pockets getting smaller. In the inspection mirror it can be seen how the damage location is filled with repair resin and becomes transparent again.
- Note in mirror when the damage location is filled. Then end injection.



Stay in this position for some time.



The resin penetrates into the cracks very slowly and may not be visible right away.



Too high of work pressure can lead to damage by lengthening the cracks or lifting the foil on old stone impacts or stone impacts with the formation of cracks.

Finish resin + hardening foil

- Cut an approximately 4 to 5 cm long piece of the foil using the blade.
- Turn the injector piston in the cylinder to approximately 5 mm remaining distance. Now remove the tool holder by moving the suction cup lever back and slightly lifting the suction cup from the window glass.
- Place the hardening film without pressure from the bottom upward on the repair location, immediately after removing the tool holder.
- Lift the hardening foil -1- from above slightly (until slightly under the crater), place a drop of finish hardener directly on the impact point and let the hardening foil return to position on the window glass.

If there are now small bubbles between the hardening foil and the window glass, remove them by lifting the hardening foil again slightly from above and then the push the air out of the

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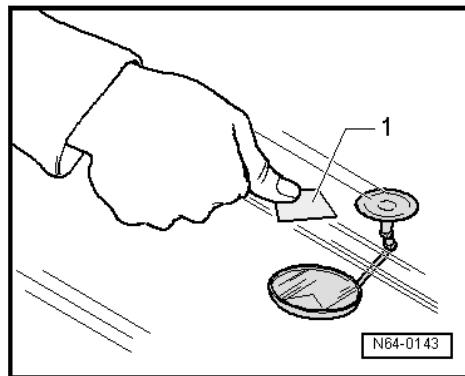
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- Immediately return injector to packaging because resin is UV sensitive and can be reused for the next repair. Replace the tool carrier in the released position in case and remove mirror with mount.

Resin, Hardening

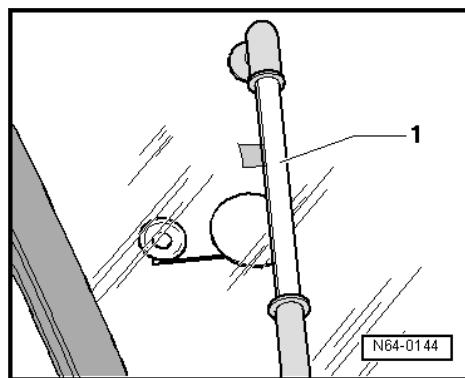
- Secure the UV lamp -1-, after coating the suction cup with vacuum gel, from the outside over the repair damage location and turn it on.

Harding the damage location is completed after approximately 10 minutes and the UV lamp can be removed from the window glass.



Final Treatment

- Scraping
- Remove the hardening film from the repair location. Hold the blade -1- at a 90° to the window glass and scrape the excess material from the damage location. The scraped resin is matte. If there are still shiny locations or a recess is present, finish resin must be applied, hardening foil positioned, hardened and then scraped again to ensure a correct flat surface.



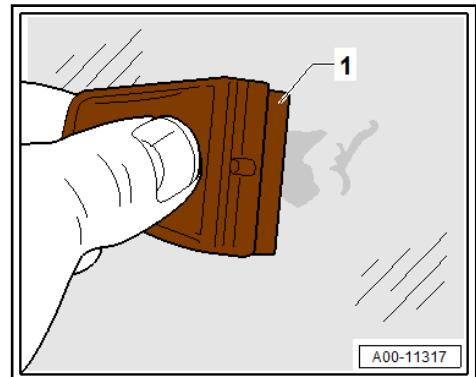
Do not push or bend up the resin because this can lead to it being pulled out of the damage location.

Only use the flawless and undamaged blades.



Note

- ◆ After the repair, the vehicle is ready to operate again without any waiting time.
- ◆ Traces of fractures cannot be removed completely with many types of breaks but they do not affect the results of the repair.
- ◆ After repair, the window is as strong as normal and further cracks are prevented by the molded and hardened plastic resin. The hardened resin is colorless and has the same refractive index as glass.



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18 Thread Repairs

⇒ “18.1 Thread Repairs on Safety-Related Components”, page 100

⇒ “18.2 Threads on Subframe Fastener, Servicing”, page 100

⇒ “18.3 Helicoil Plus Twininsert”, page 106

If damaged threads are repaired, inserts with zinc-nickel coating must be used.

Steel shavings from drilling must be removed completely.

Only replace threaded pins with original parts.

Damaged threads can be repaired with thread inserts with zinc-nickel coating.



Contact corrosion is prevented only by using this coating.

Some threads are already supplied with thread inserts at the factory.

18.1 Thread Repairs on Safety-Related Components

Depending on the vehicle-specific structure characteristics, repairs to threads such as axle or seat belt mounts are permitted are not feasible.

RO: 50 79 49 50

18.2 Threads on Subframe Fastener, Servicing

⇒ “18.2.1 Tools”, page 100

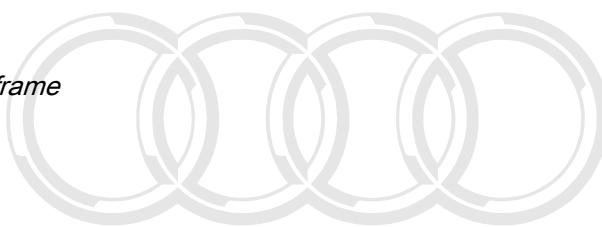


The thread repair on this vehicle is described for the subframe in the example. It is identical for the other mounts.

18.2.1 Tools

Special tools and workshop equipment required

- ◆ Thread Repair Kit M5 x 0.8 - VAS 6952-
- ◆ Thread Repair Kit M8x1.25 - VAS 6915-
- ◆ Thread Repair Kit M10 - VAS 6024-
- ◆ Thread Repair Kit M10x1.5 - VAS 6916-
- ◆ Thread Repair Kit M12 - VAS 6627-
- ◆ Thread Repair Kit M12x1.5 - VAS 6058-
- ◆ Thread Repair Kit M14 - VAS 6063-
- ◆ Thread Repair Kit M14x1.5 - VAS 6027-
- ◆ Thread Repair Kit A7/16 x 21.6 - VAS 271 009-
- ◆ Thread Repair Kit M14x1.5 - VAS 271 011-



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- ◆ Pneumatic Brush Grinder Set - VAS 6446A-
- ◆ Drill - 1100 Watt - VAS 6267 A-

Replacement Part

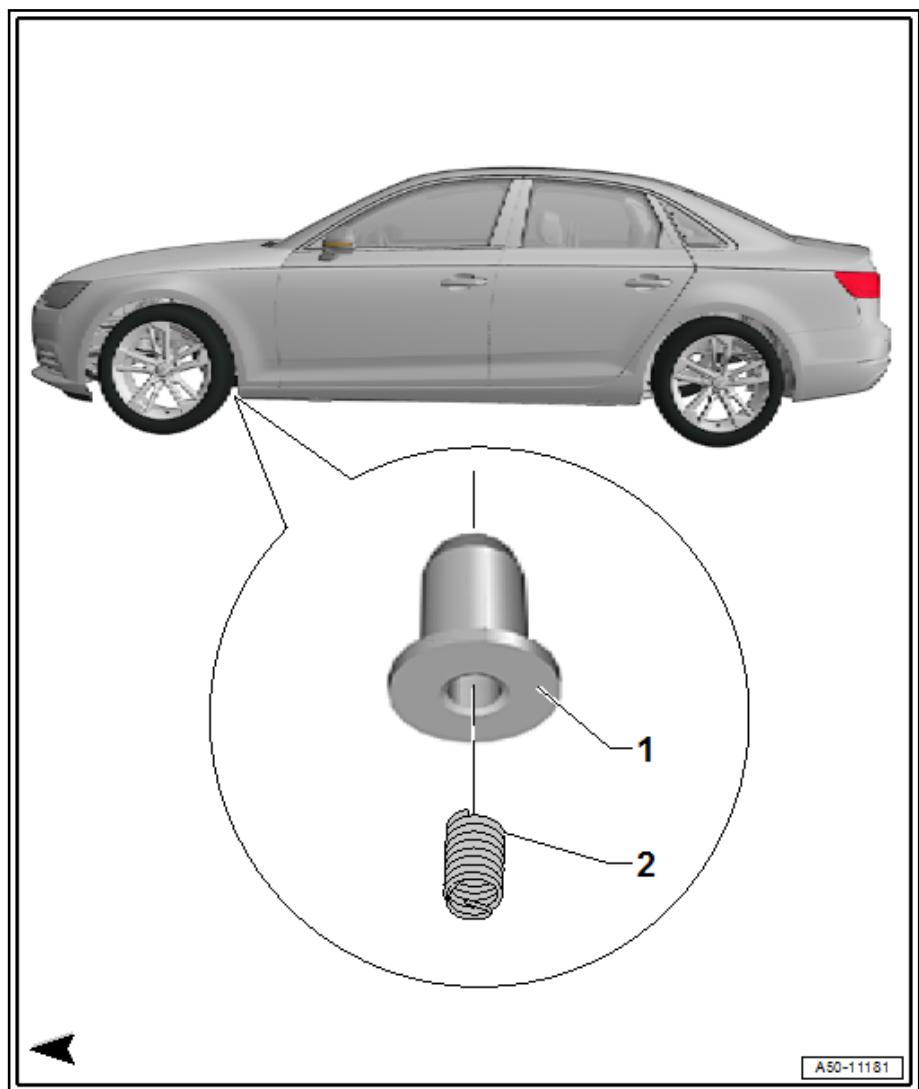
- ◆ Isopropyl Alcohol



Note

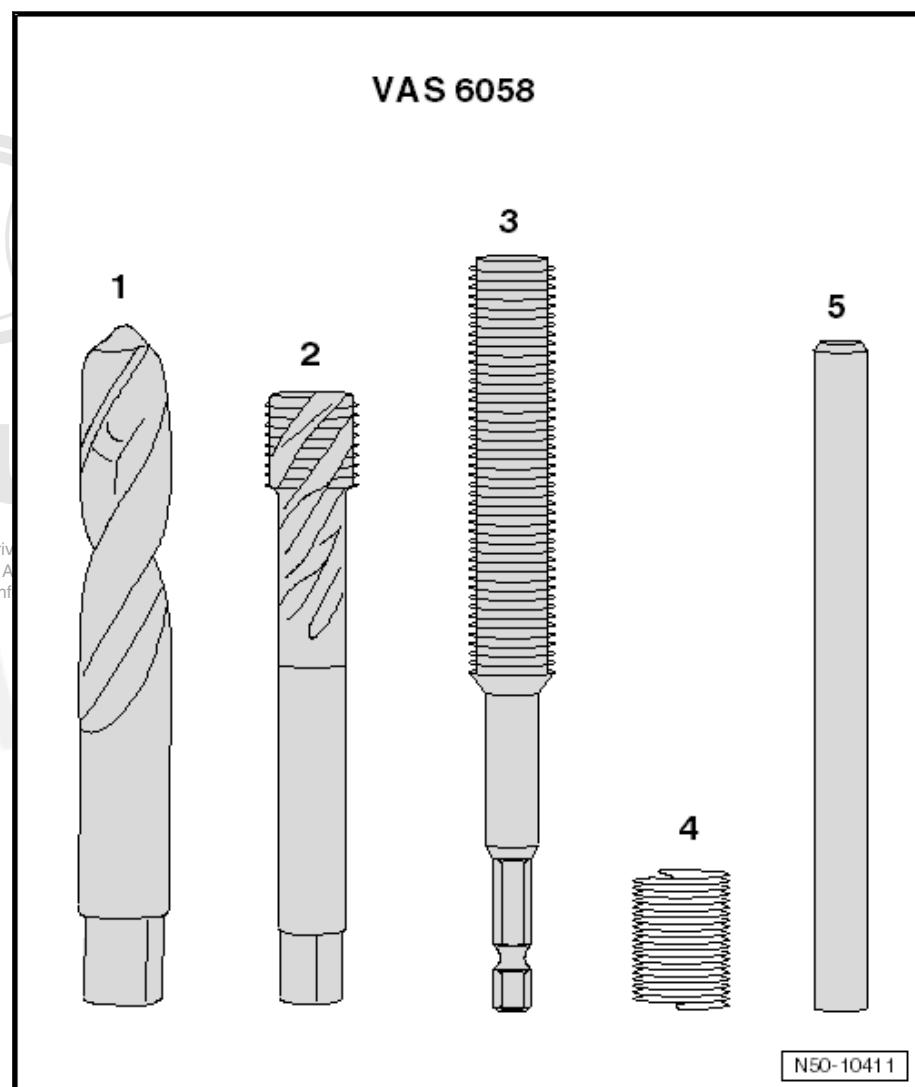
Use tools approved by AUDI AG for performing repair work correctly.

1 - Heli-Coil Insert



Thread Repair Set Contents

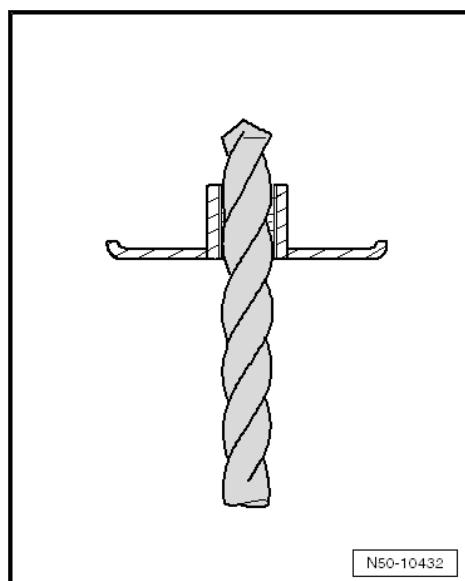
1 - Spiral Bit
2 - Thread Tap
3 - Installation Spindle
4 - Threaded Insert
5 - Tang Break-Off Tool with Magnetic Tip



Thread, Servicing

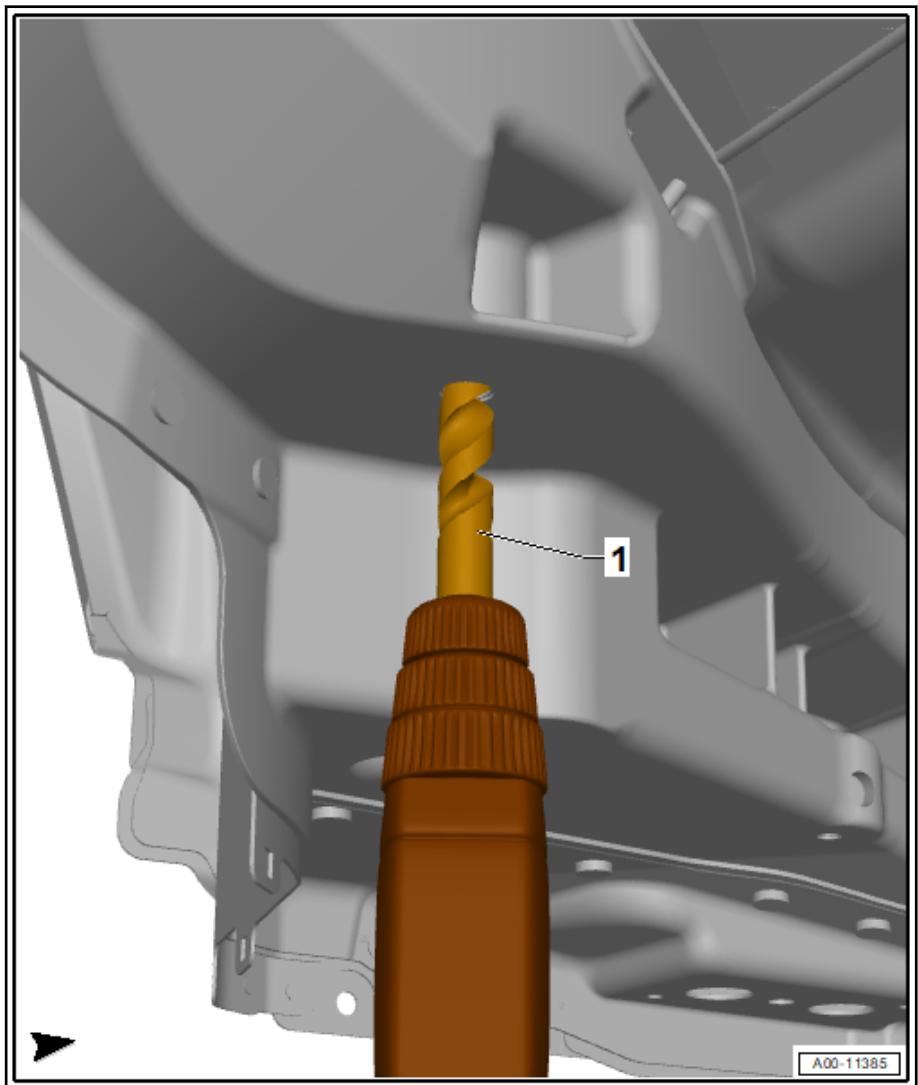
Thread, Drilling

- Drill out the threads using the spiral bit.



- Use the core hole drill bit -1- from the respective Thread Repair Kit and drill with the drill.

Clean the core hole using the Cleaning Solution - D 009 401 04- .



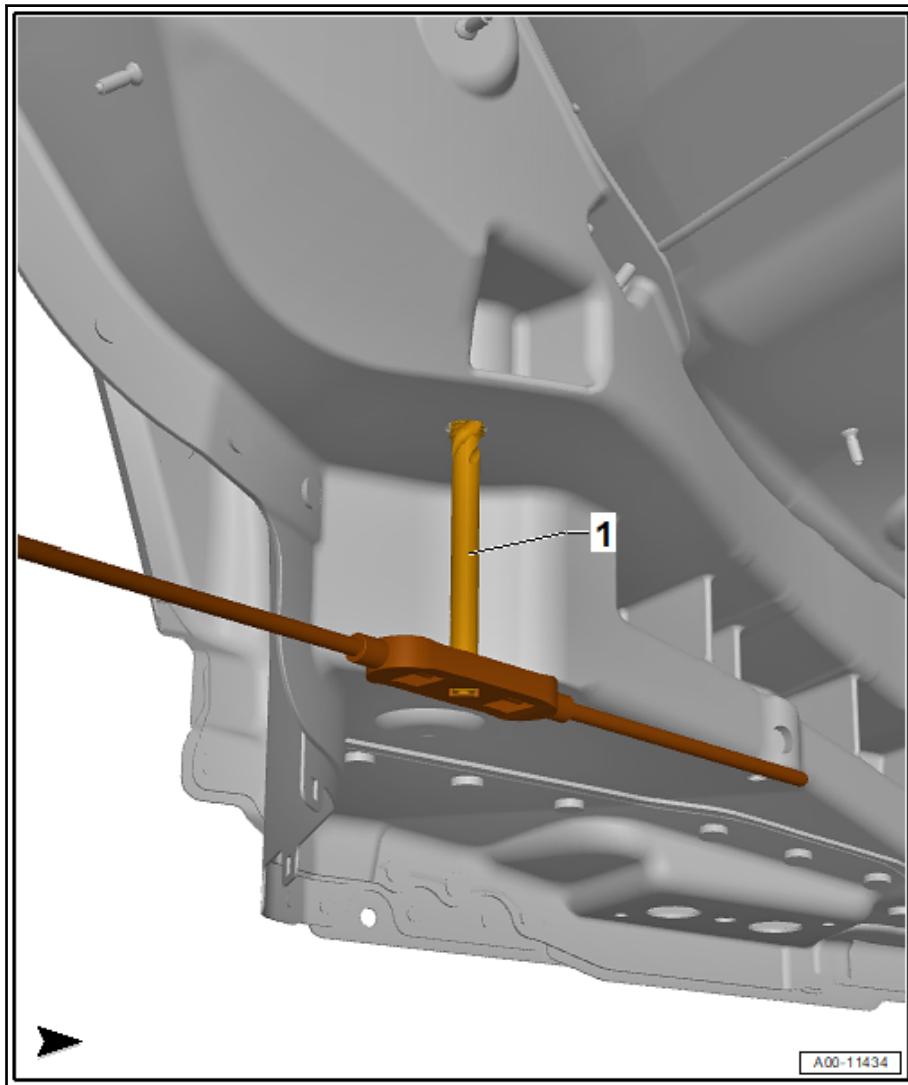
Cut the threads using the cutting tool.

Dimension = seating depth + length of the threaded bushing

Threads, Cutting

- Tap the threads using the thread tap -1- from the respective Thread Repair Kit .

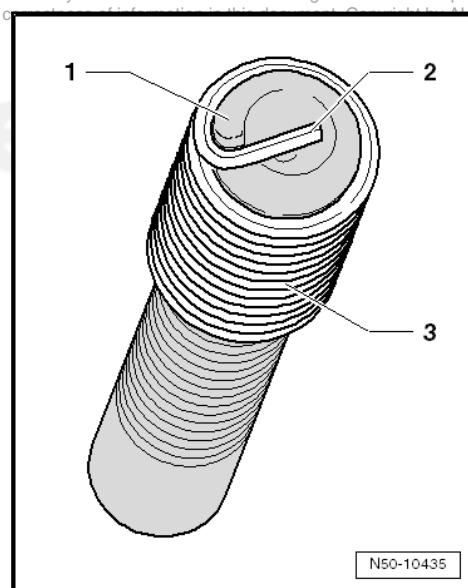
Clean the threads using the Cleaning Solution - D 009 401 04- .



Threaded Insert, Inserting

- Turn the threaded insert -3- onto the installation spindle until the driving pin -2- makes contact on the drive tab -1- of installation spindle.

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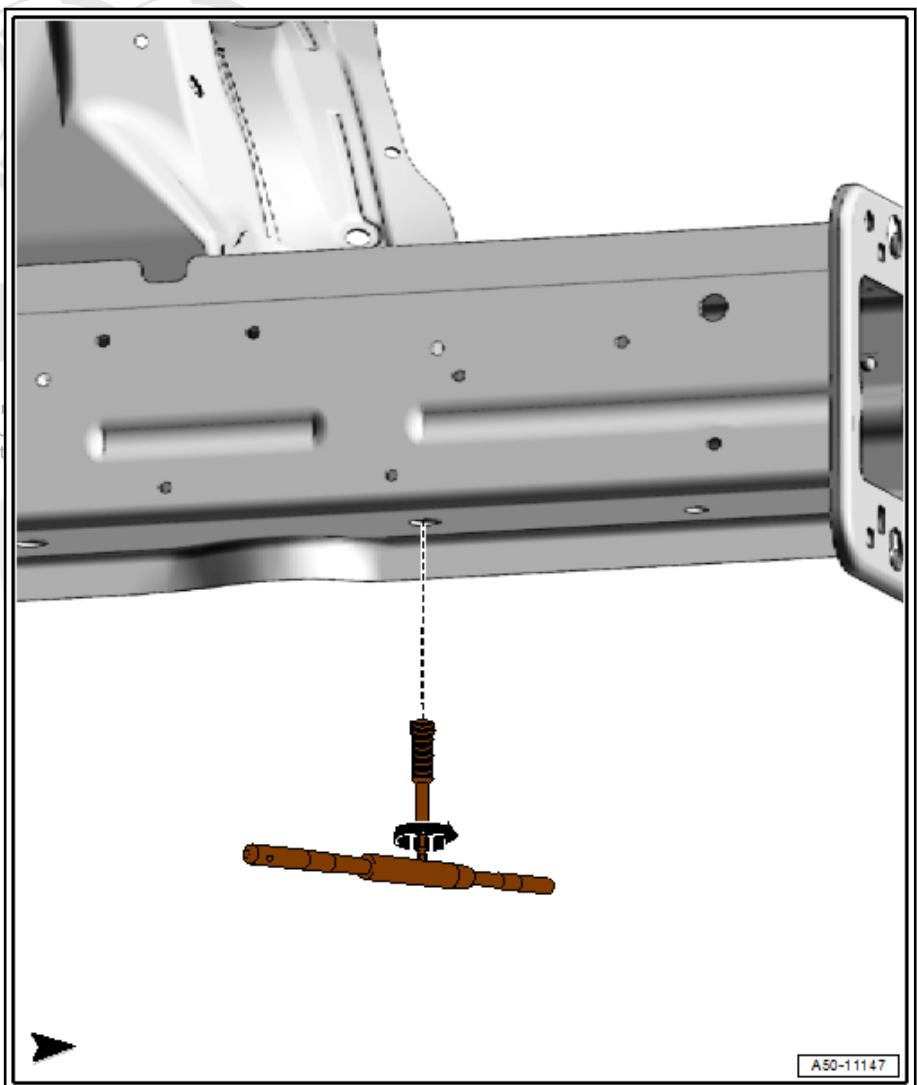


- Clean the threaded bushing (blow with compressed air).

 Note

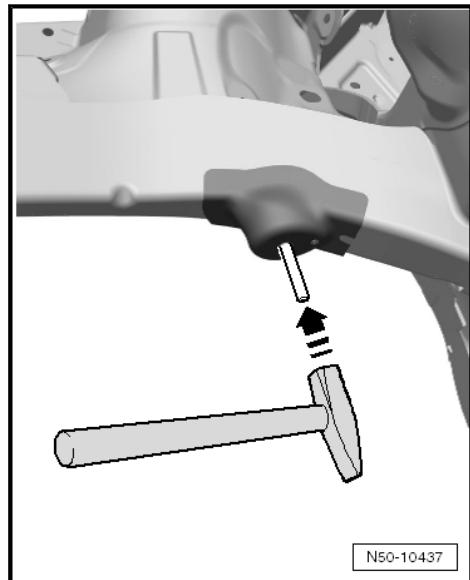
The threaded insert must be able to turn easily.

- Screw the threaded insert into the threaded plate until the threaded insert is flush with the outside of the threaded plate (visual inspection).



- Then tighten the threaded insert an additional $\frac{1}{4}$ turn inward.
- Remove the installation spindle.

- Break off the threaded insert drive pin using the pin breaker.



18.3 Helicoil Plus Twininsert

- ⇒ [“18.3.1 Faulty Threaded Insert, Removing”, page 107](#)
- ⇒ [“18.3.2 Core Hole, Drilling”, page 108](#)
- ⇒ [“18.3.3 Thread, Tapping”, page 109](#)
- ⇒ [“18.3.4 Threaded Insert, Inserting”, page 110](#)
- ⇒ [“18.3.5 Threaded Plate, Inserting”, page 114](#)
- ⇒ [“18.3.6 Pin, Breaking”, page 115](#)
- ⇒ [“18.3.7 Threaded Insert, Inserting”, page 116](#)
- ⇒ [“18.3.8 Threads, Inserting”, page 117](#)
- ⇒ [“18.3.9 Pin, Breaking”, page 118](#)

Thread repair sets

VAS 271 001

- ◆ M8 x 16 mm
- ◆ Threaded Insert - WHT 009 793-

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VAS 271 003

- ◆ M10 x 20 mm
- ◆ Threaded Insert - WHT 009 796-

VAS 271 005

- ◆ M12 x 1.5 x 24 mm
- ◆ Threaded Insert - WHT 009 794-

VAS 271 007

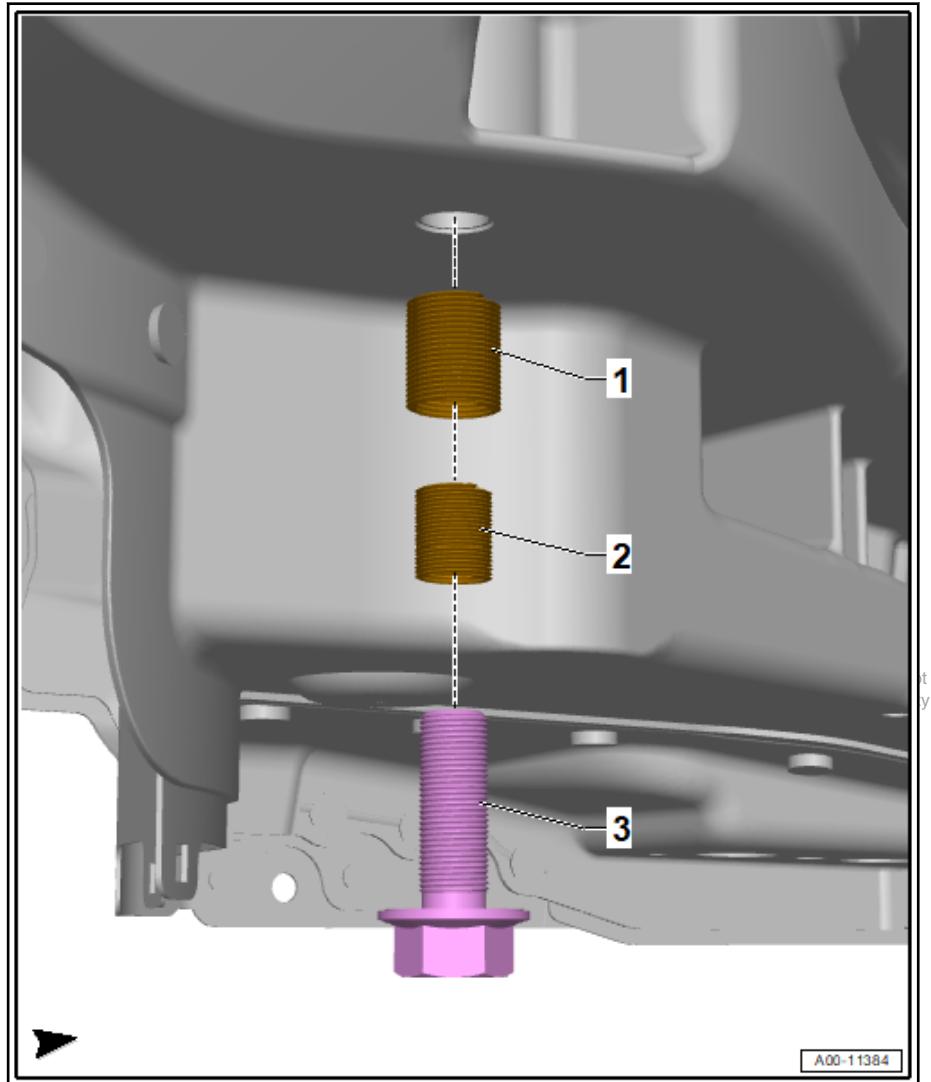
- ◆ M14 x 1.5 x 28 mm
- ◆ Threaded Insert - WHT 009 795-

VAS 271 009

- ◆ 7/16-20UNF x 22.2 mm
- ◆ Threaded Insert - WHT 009 802-

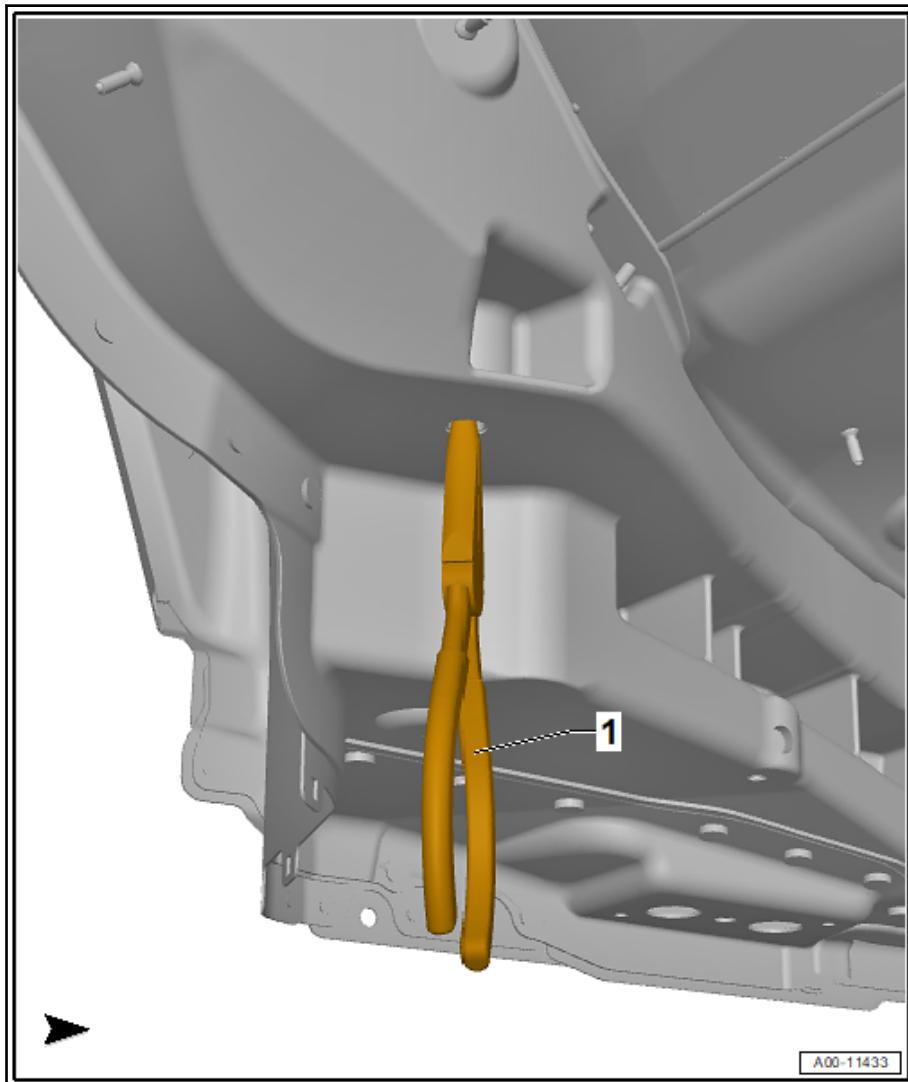
The HELICOIL® Plus Twininsert consists of two HELICOIL® Plus threaded inserts and is used when threaded holes are torn out. The outer part is a HELICOIL® Plus Free Running. The inner

insert can be chosen as needed, as a HELICOIL® Plus Free Running or HELICOIL® Plus® Screwlock.



18.3.1 Faulty Threaded Insert, Removing

- Loosen the threaded insert with a suitable screwdriver.
- Remove the faulty threaded insert using needle nose pliers
-1-.



18.3.2 Core Hole, Drilling

CAUTION

There is a risk of injury from tilting the drill.

- Use the Drill - 1100 Watt - VAS 6267 A- for drilling.
- Do not tilt the drill.

- Use the core hole drill -1- from the respective thread repair kit and drill with the drill.

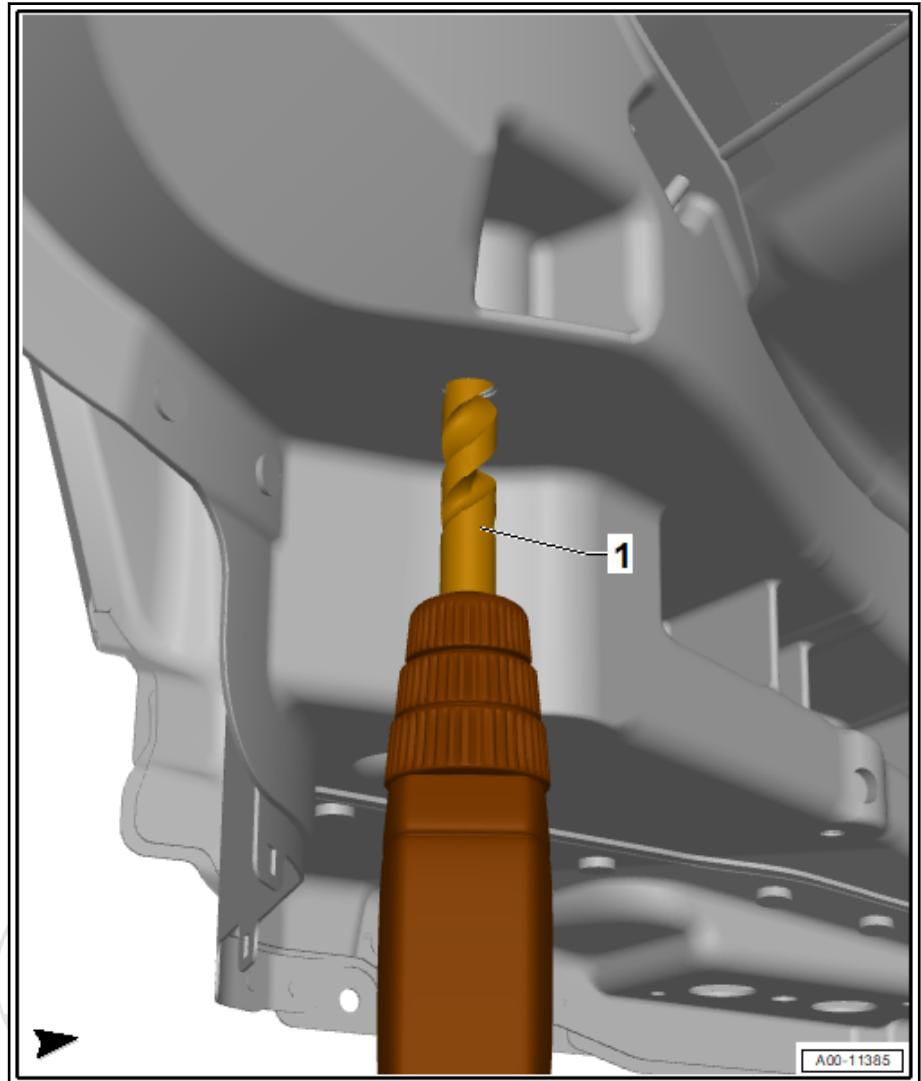
Clean the core hole using the Cleaning Solution - D 009 401 04- .



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erWin

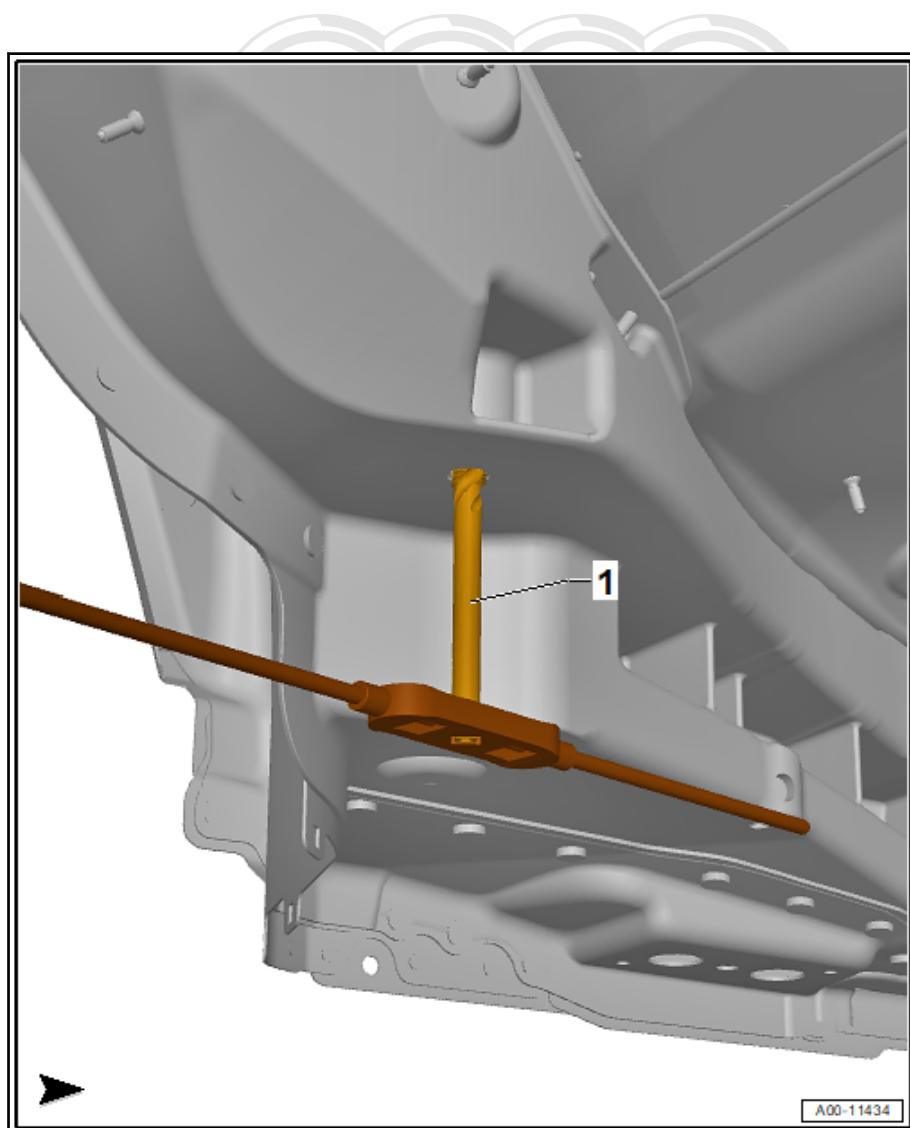


18.3.3 Thread, Tapping

- From the respective thread repair kit, tap the threads with the thread tap -1-.

Clean the threads using the Cleaning Solution **D 009 401 04**.
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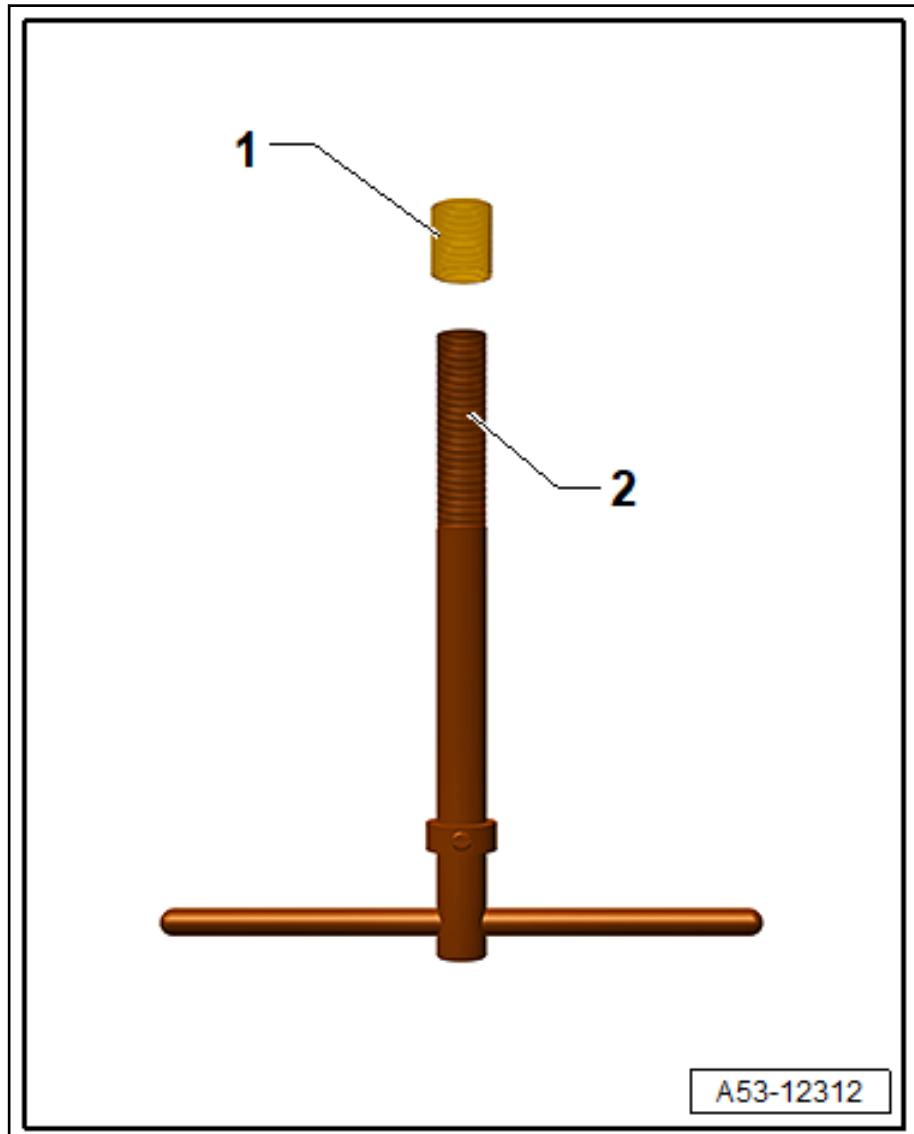




18.3.4 Threaded Insert, Inserting

Position the threaded bushing on the insertion tool.

- Screw on the threaded bushing -1- on the insertion tool -2-.



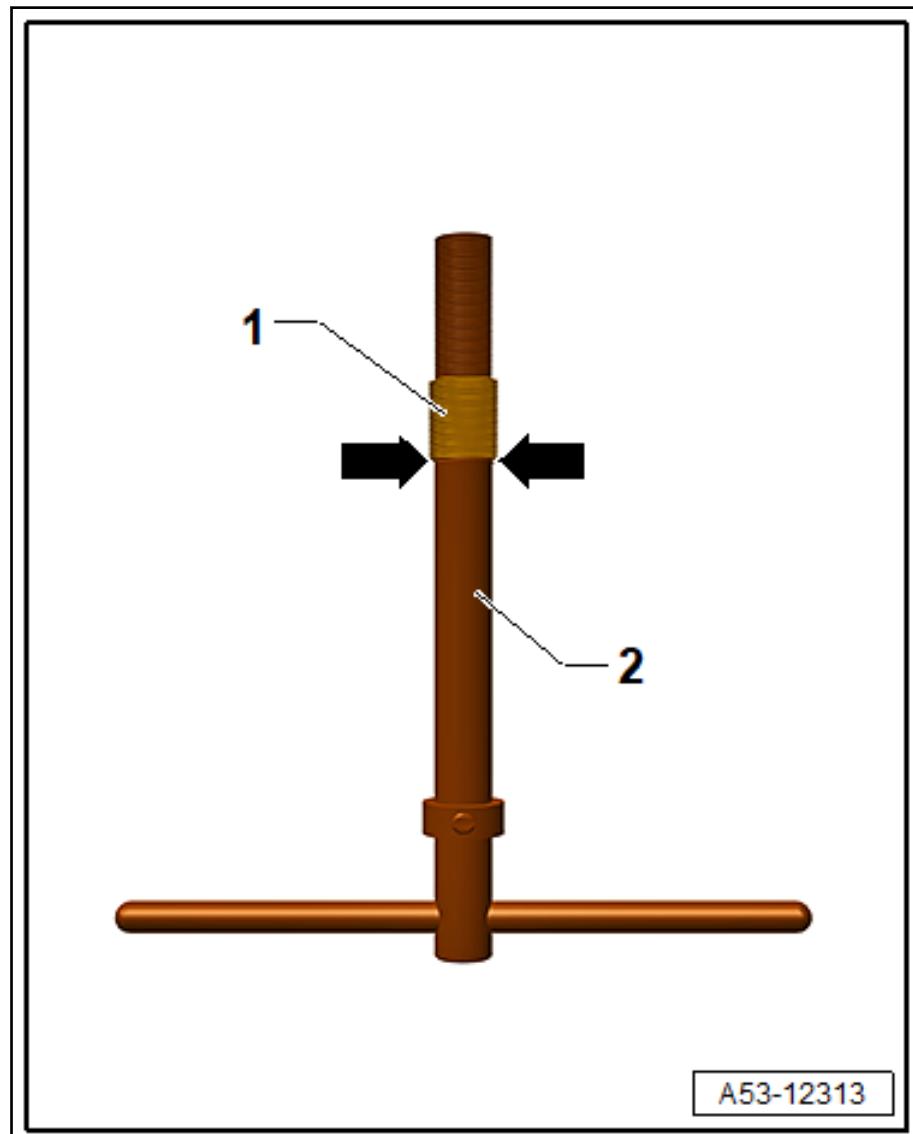
- Make sure that the threaded bushing -1- is screwed onto the insertion tool -2- completely -arrows-.



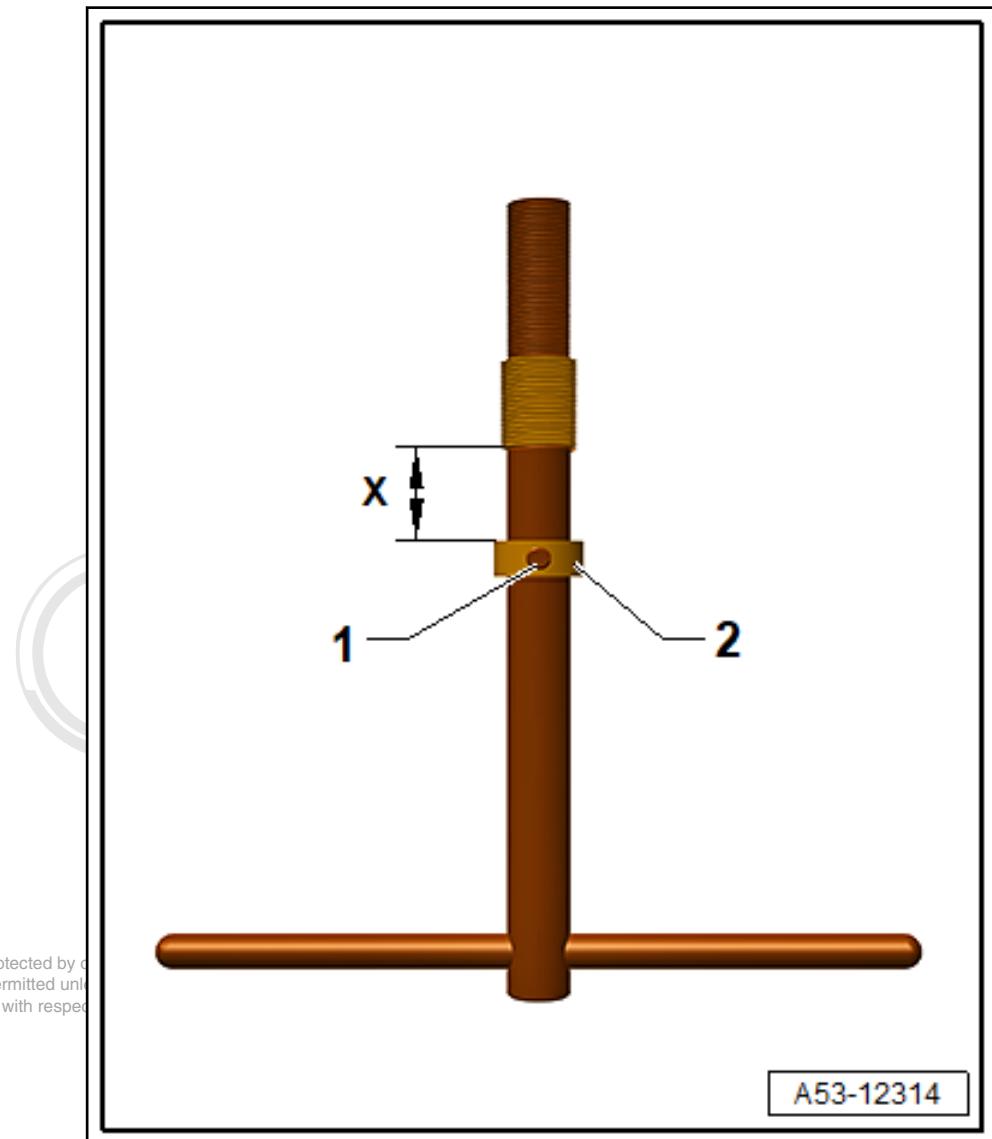
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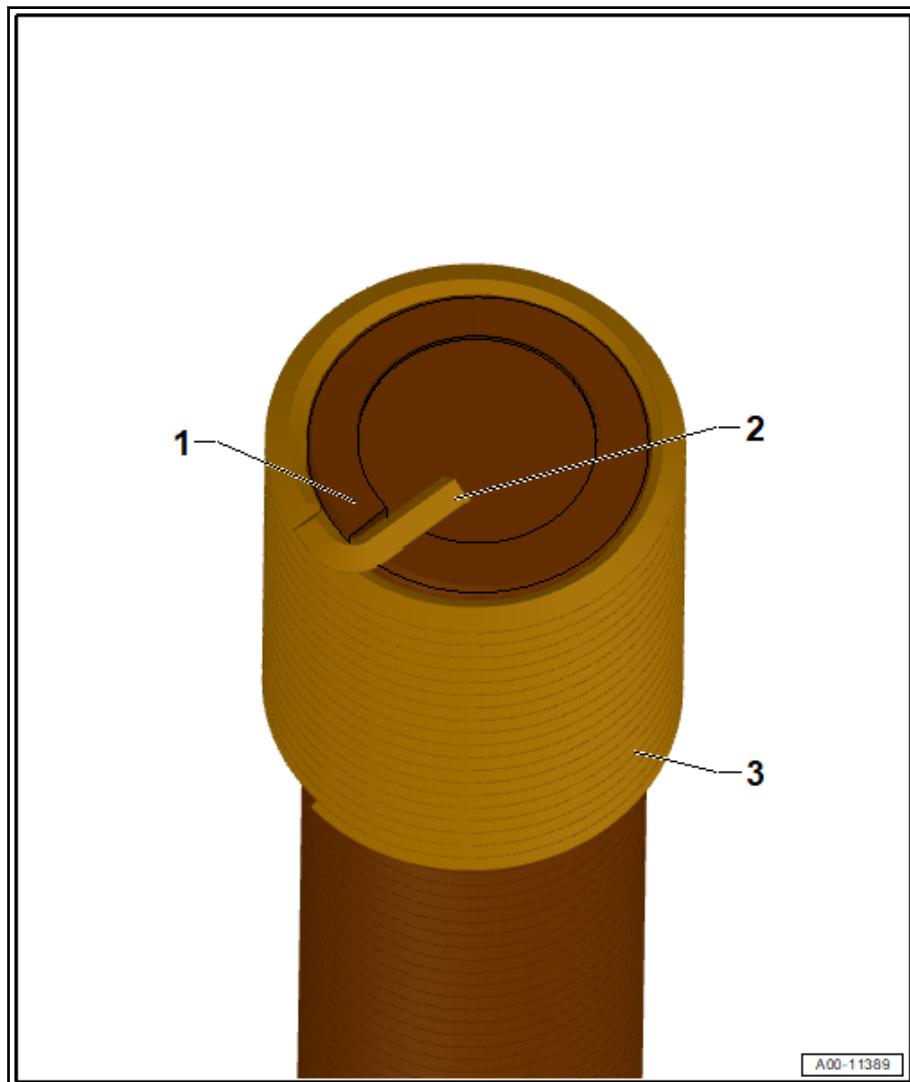
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- Loosen the bolt -1-.
- Adjust the stop -2- to the corresponding seating depth - X -.
- Tighten the bolt -1-.



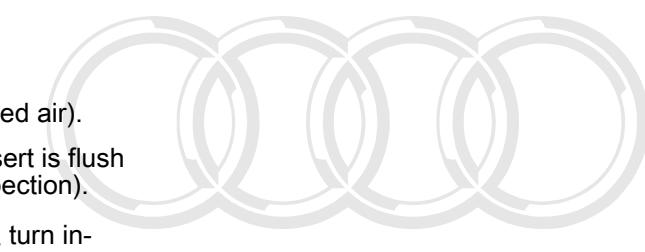
- Turn the threaded insert -3- onto the installation spindle until the driving pin -2- makes contact on the drive tab -1- of installation spindle.



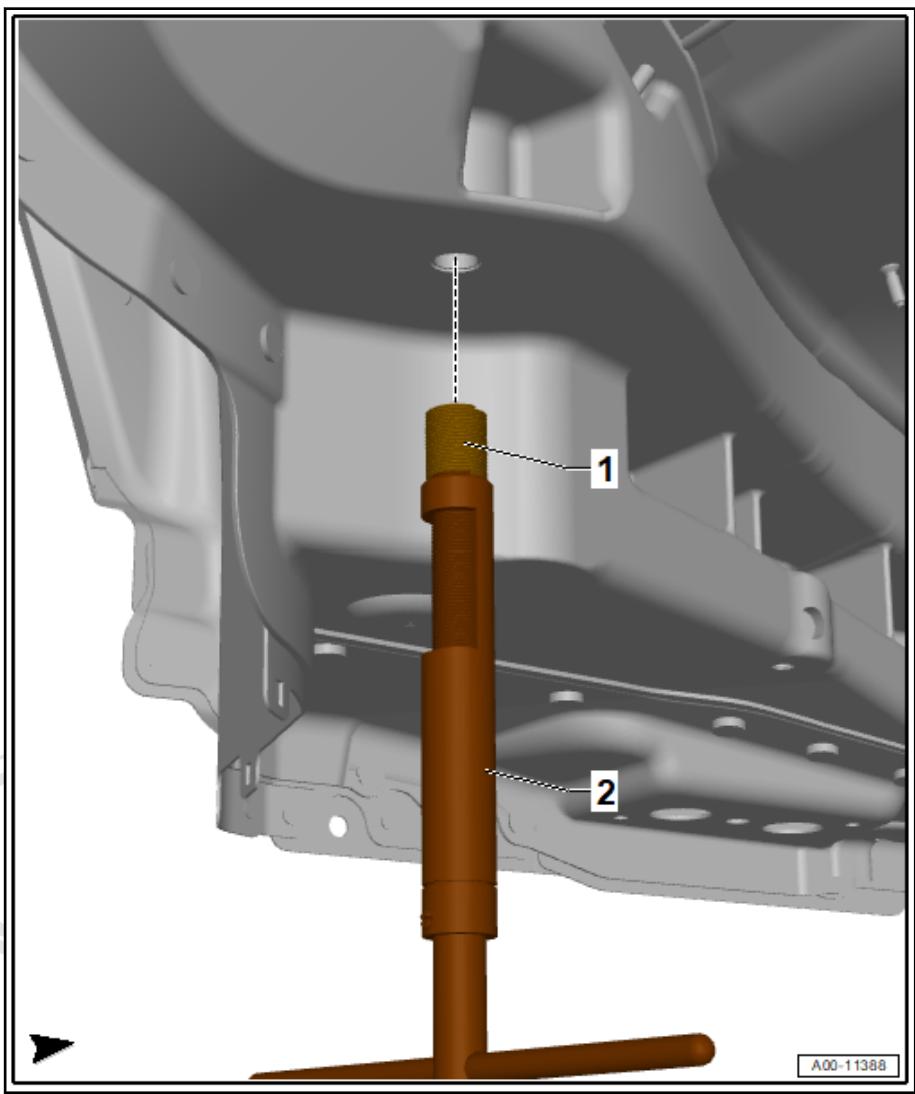
18.3.5 Threaded Plate, Inserting

- Clean the threaded bushing (blow with compressed air).
- Screw in the threaded plate until the threaded insert is flush with the outside of the threaded plate (visual inspection).
- Then tighten the threaded insert an additional $\frac{1}{4}$ turn inward.
- Remove the installation spindle.

Clean the threads using the Cleaning Solution - D 009 401 04- .



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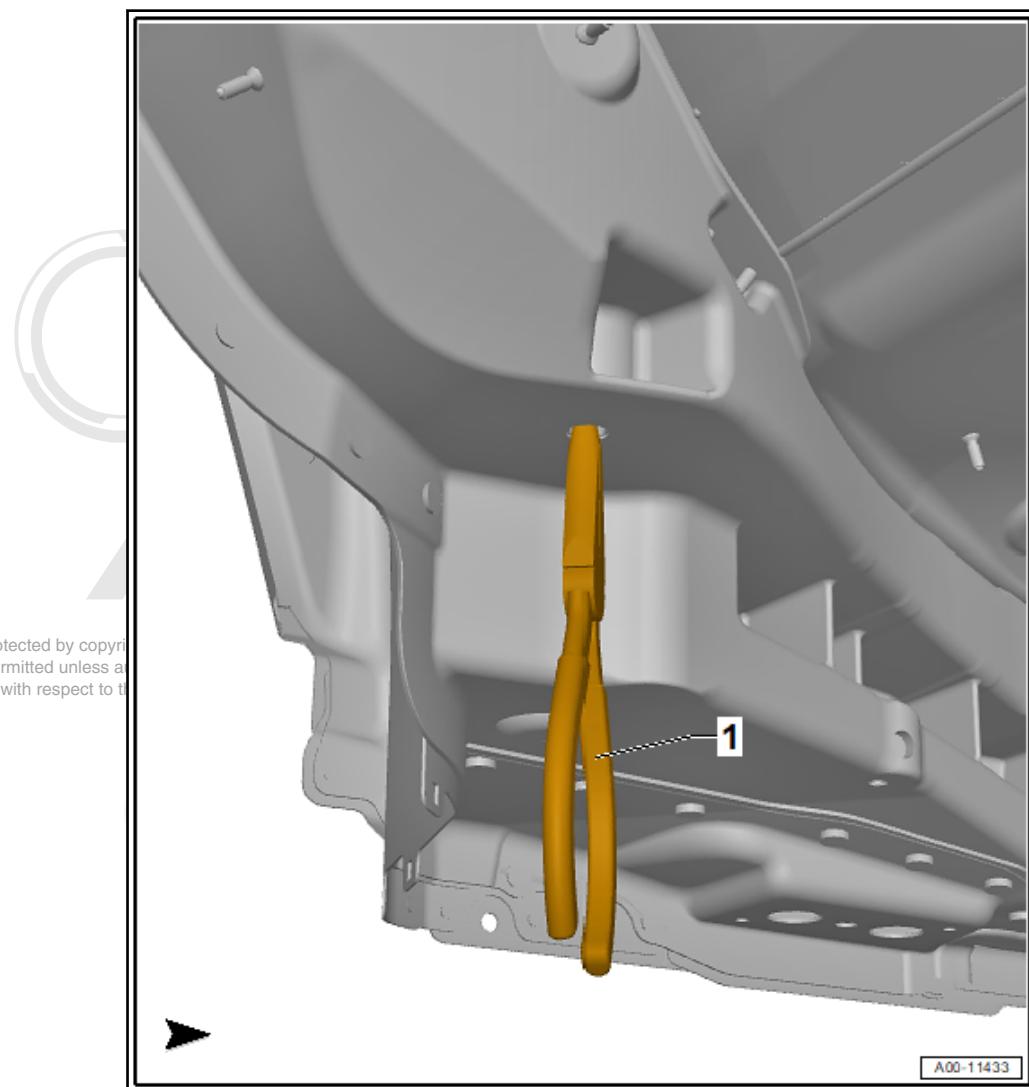


18.3.6 Pin, Breaking

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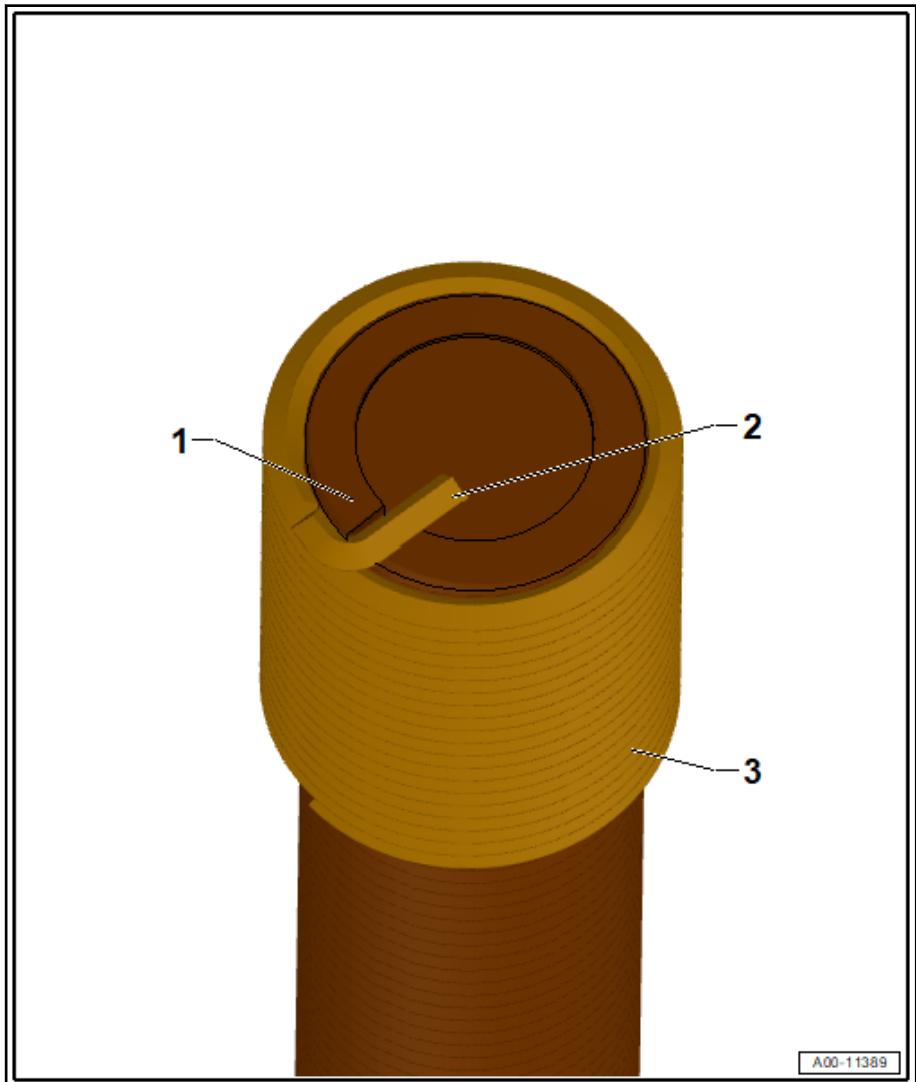
- Break off the threaded insert drive pin using needle nose pliers -1- and remove downward.





18.3.7 Threaded Insert, Inserting

- Turn the threaded insert -3- onto the installation spindle until the driving pin -2- makes contact on the drive tab -1- of installation spindle.

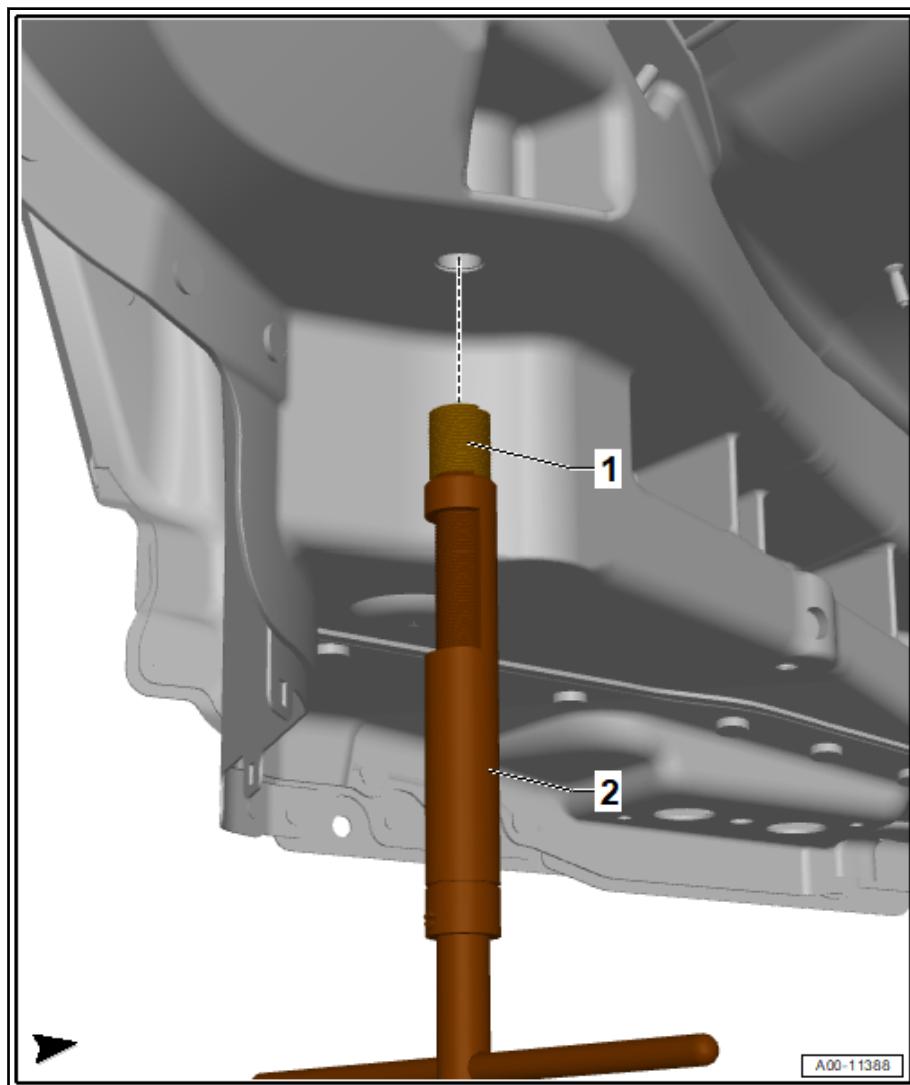


18.3.8 Threads, Inserting

- Clean the threaded bushing (blow with compressed air).
- Screw the threaded insert into the threaded plate until the threaded insert is flush with the outside of the threaded plate (visual inspection).
- Then tighten the threaded insert an additional $\frac{1}{4}$ turn inward.
- Remove the installation spindle.

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Clean the threads using the Cleaning Solution .



18.3.9 Pin, Breaking

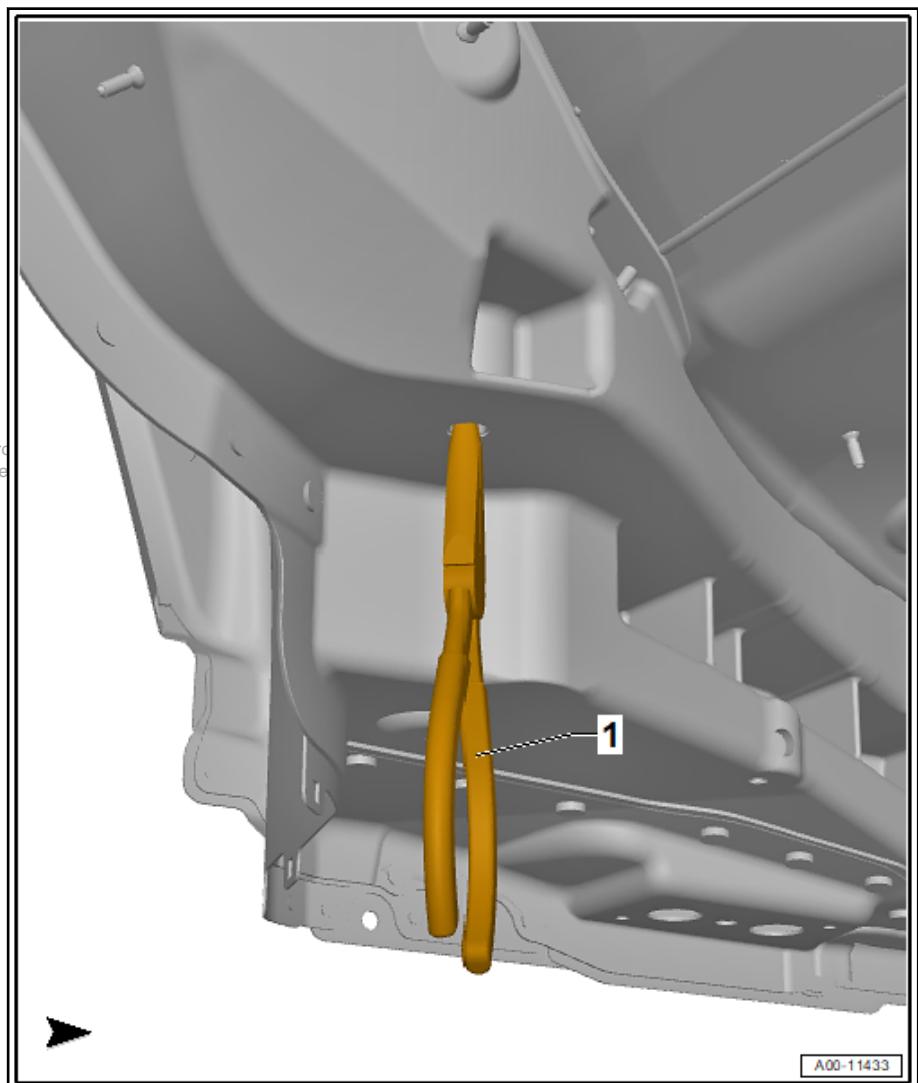
- Break off the threaded insert drive pin using needle nose pliers -1- and remove downward.

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Clean the threads using the Cleaning Solution - D 009 401-04.

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Cautions & Warnings

Please read these WARNINGS and CAUTIONS before proceeding with maintenance and repair work. You must answer that you have read and you understand these WARNINGS and CAUTIONS before you will be allowed to view this information.

- If you lack the skills, tools and equipment, or a suitable workshop for any procedure described in this manual, we suggest you leave such repairs to an authorized Audi retailer or other qualified shop. We especially urge you to consult an authorized Audi retailer before beginning repairs on any vehicle that may still be covered wholly or in part by any of the extensive warranties issued by Audi.
- Disconnect the battery negative terminal (ground strap) whenever you work on the fuel system or the electrical system. Do not smoke or work near heaters or other fire hazards. Keep an approved fire extinguisher handy.
- Audi is constantly improving its vehicles and sometimes these changes, both in parts and specifications, are made applicable to earlier models. Therefore, part numbers listed in this manual are for reference only. Always check with your authorized Audi retailer parts department for the latest information.
- Any time the battery has been disconnected on an automatic transmission vehicle, it will be necessary to reestablish Transmission Control Module (TCM) basic settings using the Audi Factory Approved Scan Tool (ST).
- Never work under a lifted vehicle unless it is solidly supported on stands designed for the purpose. Do not support a vehicle on cinder blocks, hollow tiles or other props that may crumble under continuous load. **Never work under a vehicle that is supported solely by a jack.** Never work under the vehicle while the engine is running.
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whatsoever for any damage resulting from the use of this document. Copyright by AUDI AG.
- For vehicles equipped with an anti-theft radio, be sure of the correct radio activation code before disconnecting the battery or removing the radio. If the wrong code is entered when the power is restored, the radio may lock up and become inoperable, even if the correct code is used in a later attempt.
- If you are going to work under a vehicle on the ground, make sure that the ground is level. Block the wheels to keep the vehicle from rolling. Disconnect the battery negative terminal (ground strap) to prevent others from starting the vehicle while you are under it.
- Do not attempt to work on your vehicle if you do not feel well. You increase the danger of injury to yourself and others if you are tired, upset or have taken medicine or any other substances that may impair you or keep you from being fully alert.
- Never run the engine unless the work area is well ventilated. Carbon monoxide (CO) kills.
- Always observe good workshop practices. Wear goggles when you operate machine tools or work with acid. Wear goggles, gloves and other protective clothing whenever the job requires working with harmful substances.
- Tie long hair behind your head. Do not wear a necktie, a scarf, loose clothing, or a necklace when you work near machine tools or running engines. If your hair, clothing, or jewelry were to get caught in the machinery, severe injury could result.

Cautions & Warnings

- Do not re-use any fasteners that are worn or deformed in normal use. Some fasteners are designed to be used only once and are unreliable and may fail if used a second time. This includes, but is not limited to, nuts, bolts, washers, circlips and cotter pins. Always follow the recommendations in this manual - replace these fasteners with new parts where indicated, and any other time it is deemed necessary by inspection.
- Illuminate the work area adequately but safely. Use a portable safety light for working inside or under the vehicle. Make sure the bulb is enclosed by a wire cage. The hot filament of an accidentally broken bulb can ignite spilled fuel or oil.
- Friction materials such as brake pads and clutch discs may contain asbestos fibers. Do not create dust by grinding, sanding, or by cleaning with compressed air. Avoid breathing asbestos fibers and asbestos dust. Breathing asbestos can cause serious diseases such as asbestosis or cancer, and may result in death.
- Finger rings should be removed so that they cannot cause electrical shorts, get caught in running machinery, or be crushed by heavy parts.
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- Before starting a job, make certain that you have all the necessary tools and parts on hand. Read all the instructions thoroughly, do not attempt shortcuts. Use tools that are appropriate to the work and use only replacement parts meeting Audi specifications. Makeshift tools, parts and procedures will not make good repairs.
- Catch draining fuel, oil or brake fluid in suitable containers. Do not use empty food or beverage containers that might mislead someone into drinking from them. Store flammable fluids away from fire hazards. Wipe up spills at once, but do not store the oily rags, which can ignite and burn spontaneously.
- Use pneumatic and electric tools only to loosen threaded parts and fasteners. Never use these tools to tighten fasteners, especially on light alloy parts. Always use a torque wrench to tighten fasteners to the tightening torque listed.
- Keep sparks, lighted matches, and open flame away from the top of the battery. If escaping hydrogen gas is ignited, it will ignite gas trapped in the cells and cause the battery to explode.
- Be mindful of the environment and ecology. Before you drain the crankcase, find out the proper way to dispose of the oil. Do not pour oil onto the ground, down a drain, or into a stream, pond, or lake. Consult local ordinances that govern the disposal of wastes.
- The air-conditioning (A/C) system is filled with a chemical refrigerant that is hazardous. The A/C system should be serviced only by trained automotive service technicians using approved refrigerant recovery/recycling equipment, trained in related safety precautions, and familiar with regulations governing the discharging and disposal of automotive chemical refrigerants.
- Before doing any electrical welding on vehicles equipped with anti-lock brakes (ABS), disconnect the battery negative terminal (ground strap) and the ABS control module connector.
- Do not expose any part of the A/C system to high temperatures such as open flame. Excessive heat will increase system pressure and may cause the system to burst.

Cautions & Warnings

- When boost-charging the battery, first remove the fuses for the Engine Control Module (ECM), the Transmission Control Module (TCM), the ABS control module, and the trip computer. In cases where one or more of these components is not separately fused, disconnect the control module connector(s).
- Some of the vehicles covered by this manual are equipped with a supplemental restraint system (SRS), that automatically deploys an airbag in the event of a frontal impact. The airbag is operated by an explosive device. Handled improperly or without adequate safeguards, it can be accidentally activated and cause serious personal injury. To guard against personal injury or airbag system failure, only trained Audi Service technicians should test, disassemble or service the airbag system.
- Do not quick-charge the battery (for boost starting) for longer than one minute, and do not exceed 16.5 volts at the battery with the boosting cables attached. Wait at least one minute before boosting the battery a second time.
- Never use a test light to conduct electrical tests of the airbag system. The system must only be tested by trained Audi Service technicians using the Audi Factory Approved Scan Tool (ST) or an approved equivalent. The airbag unit must never be electrically tested while it is not installed in the vehicle.
- Some aerosol tire inflators are highly flammable. Be extremely cautious when repairing a tire that may have been inflated using an aerosol tire inflator. Keep sparks, open flame or other sources of ignition away from the tire repair area. Inflate and deflate the tire at least four times before breaking the bead from the rim. Completely remove the tire from the rim before attempting any repair.
- When driving or riding in an airbag-equipped vehicle, never hold test equipment in your hands or lap while the vehicle is in motion. Objects between you and the airbag can increase the risk of injury in an accident.

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I have read and I understand these Cautions and Warnings.